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Mr. Hoover and the China Incident

HISTORY relates few instances of a great man escaping the envy, hatred, and malice of a section of his contemporaries. Mr. Hoover's record of scholarly attainment, engineering achievement, administrative success, and humanitarian service has seemingly brought to light the innate meanness of character of those in whom initiative of the better kind is lacking, and whose judgment of their fellows is warped, possibly by an uncomfortable realization of their own incapacity and the smallness of their intellectual and moral stature.

After the production and demolition of a host of stupid and vicious slanders that have appeared in recent months anent Mr. Hoover's private and public life, what is known as the China incident (1905) is revived. This particular effort to question Mr. Hoover's sense of professional honor as a mining engineer has formed the subject of attacks on both sides of the Atlantic.

In the House of Representatives, on Feb. 29, Representative A. M. Free, of California, caused to be entered in the records a letter he had received from Senator Lenroot, who summarized the incident as follows:

"The suit involved a contract between Chinese, Belgian, English and German interests, growing out of a reorganization of a Chinese industrial concern in financial difficulties, and was brought in the English court. The contracts were negotiated by agents of their respective nationalities, with the assistance of the Belgian and other legations in China. Mr. Hoover was engaged as an engineer, and later, for a short time, as manager. The real question in the case was as to the binding effect of a certain memorandum signed by Mr. Hoover as agent of one of the parties together with other agents, it being provided in said memorandum, which was made at the time of the reorganization, that a Chinese board was to participate in the management of the company and that the former Chinese director was to continue. During Mr. Hoover's administration the contract was complied with, although difficulties arose over custody of title deeds which Mr. Hoover insisted on having placed in care of a bank, in the name of the company, for the protection of all parties.

"Some eight or nine months after the reorganization was completed a change of stockholders' control took place. Mr. Hoover retired from the concern as manager, and the group which came into control then repudiated a portion of the contract made under the reorganization, by ignoring the Chinese local board of directors. Out of the change in control a bitter quarrel grew up amongst the diverse national interests. But when the issues were finally drawn it became simply a question as to whether or not the said supplemental memorandum was to be carried out. The Chinese complainants in bringing their action naturally asked as an alternative that the original contracts be rescinded and certain properties in the reorganization be restored.

"The judgment declared the memorandum to be valid and binding, dismissed all other questions except as to damages for breach of the contract, and, upon appeal, even this was dismissed as to the concern for which Mr. Hoover had acted as agent."

The *Congressional Record* of Feb. 29 prints several letters and documents, all of which go to prove that Mr. Hoover's conduct in this connection was that of a gentleman and an engineer who had observed the highest ideals of professional ethics. It is difficult to summarize the evidence, but it should be read by all who are interested in this one phase of the career of Mr. Hoover. Even in the limited space available, it is possible, however, to present a few extracts from the testimony.

At the time of the reorganization mentioned in Senator Lenroot's statement, Baron de Cartier, later Belgian Ambassador to the United States, represented the Belgian interests while acting as Belgian Chargé d'Affaires in China. In 1917 he wrote to Mr. Hoover, expressing astonishment at the nature of the misstatements current, and said: "Throughout your administration of the company's affairs, both as chief engineer and as director, you acted concededly for the best interests of all the stockholders—Chinese, Belgian and English alike—with the highest sense of honor; and the termination of the litigation was a complete vindication of your conduct and largely turned upon your testimony."

The chairman of the board of directors of the company against whose interests Mr. Hoover testified wrote under date of April 18, 1923, in part as follows:

" . . . I am able to say that there is no ground for any suggestion that Mr. Hoover's conduct in relation to the matters in question has been other than of a perfectly honorable character."

The only surviving barrister in the case, Mr. T. R. Hughes, said that " . . . So far as my recollection goes there was no evidence in that case which in any way reflects on the honor or integrity of Mr. Herbert C. Hoover."

Mr. Harry G. Abrahams, of Messrs. Michael Abrahams Sons & Company, of London, who represented one of the defendants in the action, gives the history of the case in detail. In conclusion, he says:

"Some criticism was raised as to the forcible possession of certain bearer-title deeds at Mr. Hoover's direction when manager. As a matter of fact, these deeds were not taken by force but were rescued from corrupt use by certain Chinese officials and placed in a foreign bank and in escrow for all parties; there was absolutely nothing in it—except loyalty to the concern."

Finally, we reprint the testimony of Mr. Arthur C. Train, not only a distinguished American lawyer but the author of stories that reflect a high and human appreciation of the difference between right and wrong, between knavery and uprightness, apart from technical interpretation or decision. Mr. Train says:

"The only persons in a position to complain of Mr. Hoover's conduct or testimony in the case were the British and Belgian groups against whom his testimony lay. Yet these same British groups all of them engaged his engineering services in after years, and the Belgian group were the identical men who appealed to him to undertake the relief of Belgium upon which they entrusted their lives and their own enormous contributions implicitly.

"In conclusion permit me to say that, were it not for the possible misrepresentation of this matter as filthy political defamation, it would be difficult for me to see why there was any necessity for engaging the services of my firm for the purpose of reviewing his part in this long-defunct litigation, where the ensuing operations were carried on with great profit for many years to the satisfaction of the Chinese and Europeans alike, and whereby his positive and disinterested testimony assisted in procuring justice for all parties concerned."

Enough has been said to still the mean rumors anent Mr. Hoover's connection with the China incident and to depict him as a capable engineer and executive with a high appreciation of the niceties of professional ethics and sympathetic of the rights and privileges of all, irrespective of nationality. The evidence merely confirms the oft-repeated statement that Mr. Hoover ranks among the greatest living Americans—great by virtue of an ability and zeal for achievement in many fields of endeavor. The contrast between him and his detractors becomes more marked every day. In thinking of them one is reminded of the columnist's quip: "Science has discovered something smaller than the atom; but no names are mentioned."

The Dust Problem In Dry Milling Plants

NO GENERAL survey of the mining industries can fail to uncover conditions in the field of hygiene and welfare that deserve immediate consideration. The cause in some quarters is deep seated. Because of intensive price cutting, the full play of that competition which merely enervates the contestants, and the reduction of profits in the direction of the vanishing point, the plea can be made by many a mining company that it lacks the wherewithal to take adequate steps to safeguard the health of employees, usually the last matter to be considered by a physically robust board of directors, whose duties do not bring them into contact with much suffering or misery. The general manager, however much he may personally deplore the continuation of conditions that would call for prompt remedy if they obtained in a factory, works with an eye on the cost sheet; and the mill superintendent feels that he can be replaced promptly should he display an unduly sympathetic concern for the health of his subordinates.

Conditions in many plants in regard to dust are appalling, yet it is common to find that an engineer who may have specialized in its control is afraid to disseminate the knowledge gained by an experience in solving the problem, and is warned that the company concerned does not wish attention drawn to this serious industrial hazard. Under such conditions, the menace becomes greater year by year; but the day of reckoning cannot be postponed indefinitely.

At one plant visited not long ago the conditions prevailing violated all accepted principles of hygiene and good business. The neglect to give even a thought to the health of employees was short-sighted and costly. Though a sense of humanitarianism might be lacking, some attention should have been paid to the condition of the machinery, which deteriorates under such conditions as surely as do the humans operating it. In the accounts, however, a full allowance is made for plant depreciation, indicating a concern for the functioning of the inanimate that reproduces faithfully the mechanistic attitude of mind of so many controlling officials.

An engineer of our acquaintance, in good health eighteen months or so ago, accepted an engagement with the company operating the plant mentioned. After zealous attention to duty under the conditions prevailing, with those around him apparently oblivious to the trend of his health, he went into a rapid tubercular decline, and now lies bedridden and helpless—a victim of only a comparatively short exposure to a dust-laden atmosphere. No excuse can be offered for the deplorable working conditions prevailing in this instance. The company operating the plant is a powerful one, with ample funds in its head-office treasury to take those precautions that decency and a common respect for human life would indicate as essential. The fault occasionally lies with controlling officials and consulting "experts," the cost of whose technical mistakes may involve the expenditure of money that should have been voted to a fund designed to secure and maintain decent working conditions for those whose duties involve continuous exposure to an atmosphere that, if not freed of dust, is responsible for disorganization, high labor turnover, sickness, discontent, and loss of life.

The hazard of the kind discussed does not cause instant death. The period between incubation and serious illness may be so prolonged—a sound physique may fight incipient disease for many months or even years before collapse—that cause and effect are not easy to connect, or the connection seldom can be proved. If the mining industries are to deserve respect, and if stockholders are to feel that their income from investment in the mining industries has not been gained to any extent at the expense of suffering and sickness, a radical change of policy at some properties is imperative.

Far-sighted and humanitarian executives — and we realize that there are many—who know that dust collection is not only good engineering but good business, are invited to take greater advantage of existing avenues of publicity in describing recent methods and results. The outcome should shame into action those who are still apathetic or guilty of deliberate neglect.

Society Promotion and the Encouragement of Geophysics

BUNCOMBE strongly flavors a circular received from the self-styled "American Society of Geophysics." With the circular comes a letter the writer of which seems to have heard of geophysics only in its application to mineral prospecting. "Geophysics is a new science and therefore needs the ardent support of all concerned," the "secretary" says. "The American Society of Geophysics is especially indebted to those who have helped to put this science in its rightful place of academic recognition, and in consideration of services rendered, and to be rendered, this Society has established a number of Honorary Memberships."

One of these, the editor is promised, is to be bestowed, together with a "small advertisement," upon *Engineering and Mining Journal*. An advertising rate card is requested, "in order to enable us to chose the appropriate size of advertisement within our limited budget." The request is made for a letter "stating that you will do everything in your power to help us furthering the advancement of geophysics. . . ."

A certain "Prof. Dr. Herzog," who is said to be engaged at present in scientific research at Vienna, is declared to be the honorary president of the organization, which, so the circular states, is the United States branch of the "International Society for the Advancement of Geophysics." The local organization has temporary headquarters at Lincoln University, Phelan Building, San Francisco; and it is to be noted that "Professor" Herzog "has recently been awarded the esteemed academic degree of 'Doctor honoris causa' by Lincoln University," which, it is presumed, will entitle him to the use of the letters D. H. C. after his name!

It is believed that the information given will enable readers of *Engineering and Mining Journal* to classify the "American Society of Geophysics" where it rightfully belongs.

On the Selection and Purchase of Lubricants

GREATER attention is being paid to the character and mode of application of lubricants. It is now widely recognized that they must be chosen according to the kind of equipment to be lubricated. Years ago, makers of the finest Swiss watches used a particular kind of oil—made from the jaw of the porpoise—for oiling the mechanism of their products. In contrast with this sense of delicate selection might be placed the unconcern of many early mining operators who regarded almost any oil as good enough for lubricating rock drills.

The attitude of mining men has changed since then, and they have learned that low-cost oil may be expensive in the long run because of the quantity required and the resultant damage to machinery. A mine manager in Mexico recently told us that he had thought that costs in the mine and plant under his control had been cut "to the bone" by the use of a low-priced oil purchased locally. On changing to an oil of a well-known brand marketed in the United States, however, he discovered that lubricating costs were reduced to 40 per cent of the former figure, despite the fact that the substitute cost twice as much per unit of quantity. Another operator found that a cheap grease remained only a few minutes on the bearings of a sintering machine.

The selection of an unsuitable lubricant may be actually harmful because of the formation of a sludge or emulsion. Furthermore, it has been proved worth while in many plants to invest in modern greasing equipment, to insure uniform lubrication, the avoidance of waste and the safety of employees.

Advice on how to chose the proper lubricant and how to use it is easily obtained. Much has been written on the subject. The leading refiners are a convenient source of information and advice. The large number of brands and grades on the market, however, is confusing to the purchaser unless he has a broad background of experience with which to guide him in selection. Here an opportunity exists for simplification. It is suggested that the production of fewer grades, each conforming closely to standardized specifications and suitable for a particular range of service, would be advantageous to refiner and consumer. Moreover, the adoption of a standard nomenclature for brands, to supplement the trade names used, would permit the ready correlation of competitive products. This would facilitate the task of selection by taking much of the guesswork out of buying.

Determination of Alkalinity and Acidity

IN GENERAL hydrometallurgical and ore-dressing work, the tendency has been to place little emphasis on the importance of the precise control of alkalinity or acidity in the water or chemical solution used; this has prevented a clear conception of the vast importance of either factor as an influence in the checking or accelerating of chemical, physical, and electrical effects in the aqueous vehicle. Alkalinity is usually determined in terms of an alkaline salt, such as caustic soda or lime, sometimes as a percentage and sometimes as so many pounds per ton. Acidity is generally reported as a percentage in terms of a standard acid. The absence of a single scale that would indicate, with scientific accuracy, the degree of alkalinity or of acidity has served to complicate analysis and to prevent a clear understanding of the fundamental cause of either. If one accepts the theory of electrolytic dissociation—that all aqueous solutions contain OH and H ions—it is evident that equality in the number of such ions represents neutrality; an excess of H ions, acidity; and an excess of OH ions, alkalinity.

A single thermometer may be used to register what we consider a high temperature, as well as what we consider a low temperature; what "feels" hot and what "feels" cold. It is equally logical to use one scale to represent the ratio of H to OH ions in an aqueous solution, which is equivalent to the degree of alkalinity or the degree of acidity. In the hydrogen ion scale, as it is called, neutrality is represented by the figure 7, the result being recorded as pH 7. An increase in the number represents an increase in the alkalinity; and a decrease in the number, an increase in the acidity. A pair of tests, for instance, giving pH 7.4 and pH 6.2, respectively, provide all the information needed and in much simpler form than if the results were recorded as a percentage alkalinity in terms of some standard alkaline salt, and as a percentage acidity in terms of some standard acid, respectively. Control of testing is less complicated and much more positive by the pH system than by the generally accepted methods.

The adoption of the newer and more scientific scheme of testing and recording will result in a fresh conception of the fundamental influence in metallurgical work of H or OH dominance in the solutions used. Under more accurate control a better coagulation of colloidal matter released during grinding will be effected, and an economy will result in the amount of electrolyte, usually lime, used. It will enable a closer control of the alkalinity factor in relation to the extraction of gold and silver by cyanide, and it will encourage research in the selective flotation of a mineral or minerals, in connection with which the maintenance of a predetermined alkalinity or acidity is an important factor. To those who are interested, it is pertinent to state that an excellent primer on the subject is available for distribution by the LaMotte Chemical Company, of Baltimore, Maryland, entitled "The ABC of Hydrogen Ion Control." Another, entitled "Hydrogen Ion Concentration—Its Control in the Flotation Process," has been issued by the American Cyanamid Company.

The Big Bug Mining Area in Arizona

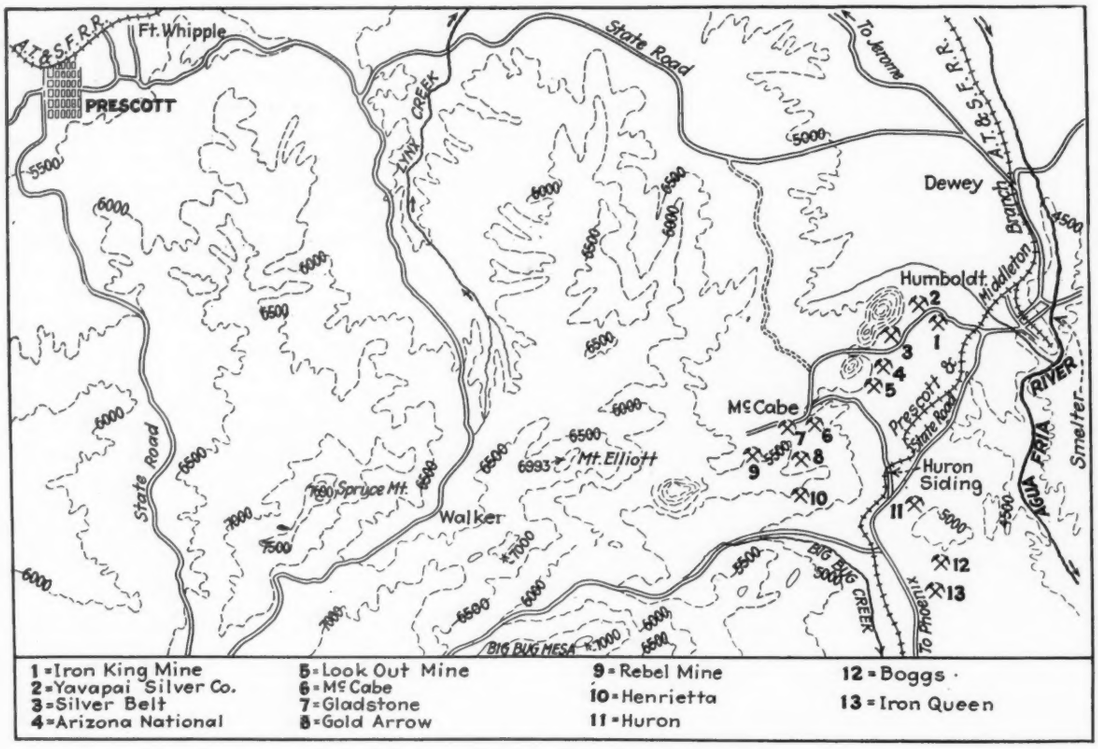
An Old District that Gives Promise of a Renewed Activity Because of Improved Methods of Prospecting and Concentrating

By Lloyd T. Emory

Consulting Engineer, Philadelphia, Pa.

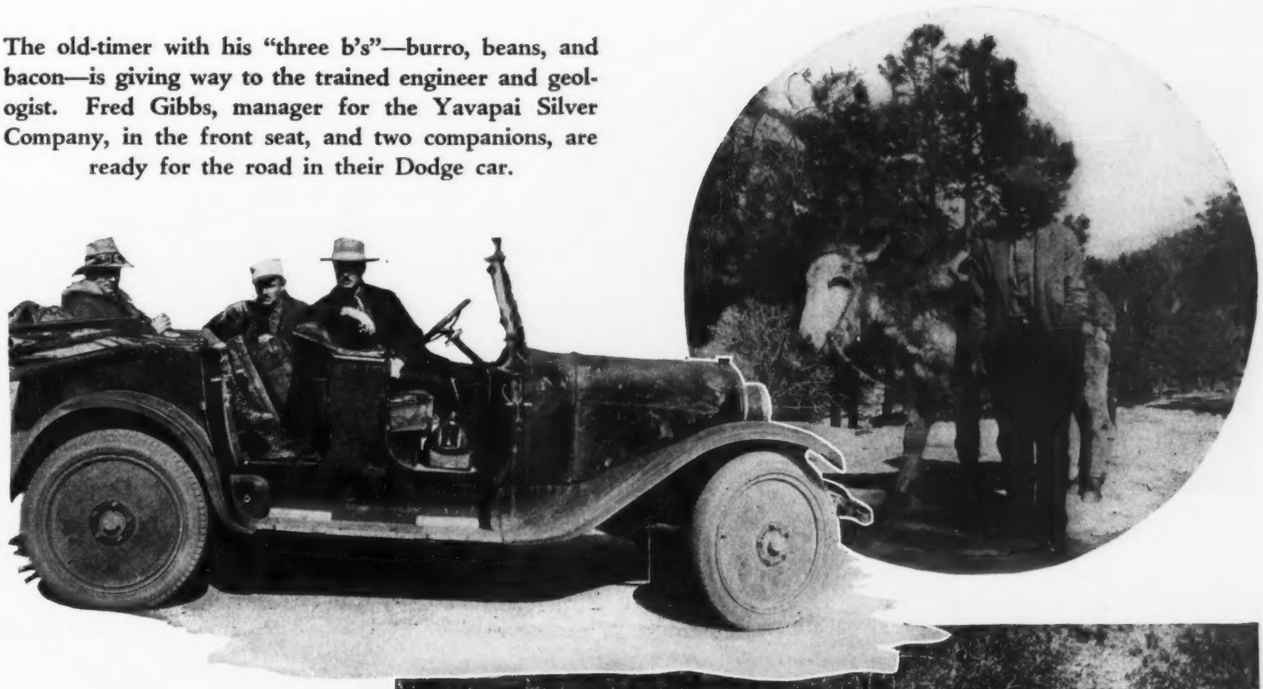
THE BIG BUG mining district is one of the highly mineralized sections of Arizona. Worked since 1870, it has produced large quantities of gold, silver, copper, lead, and zinc ores. The accredited production from 1901 to 1924 inclusive, according to the U. S. Geological Survey, had a value of $16,578,536. It is probable that if all the zinc in the silver-lead ores had been recovered this figure would have been much higher. The peak year in this period from a financial point of view was 1918; but war prices must be considered in reviewing the yearly production figures. War conditions stimulated certain metals and depressed others. In the readjustment decline, which reached the bottom in 1921, many properties that had produced were closed down and have since been inactive. Improved transportation facilities, modern milling equipment, capable of separating complex sulphide ores, and the steady demand for lead and zinc have revived numerous mining districts in our Western states, and it is probable that these changed conditions will have a beneficial effect on the Big Bug area.

The Big Bug district is situated on the northeast slope of the Bradshaw Mountains in the central part of the state. Its elevation increases from 4,500 ft. above sea level near the Agua Fria River, to more than 7,000 ft. at the edge of Big Bug mesa. The district is primarily composed of the drainage area of the Big Bug Creek, but it also includes some territory around the Humboldt smelter. The distance from Prescott over the Black Canyon highway, which runs through the eastern part of the area, is a little more than 20 miles. A branch line of the Santa Fe railroad closely parallels this highway and a spur line runs up Big Bug Creek to the entrance of Poland tunnel. Country roads which are easily traveled by light motor cars and trucks reach nearly every mine. The topography is somewhat broken and the lower slopes of the valleys are steep; but the canyons and scarps which

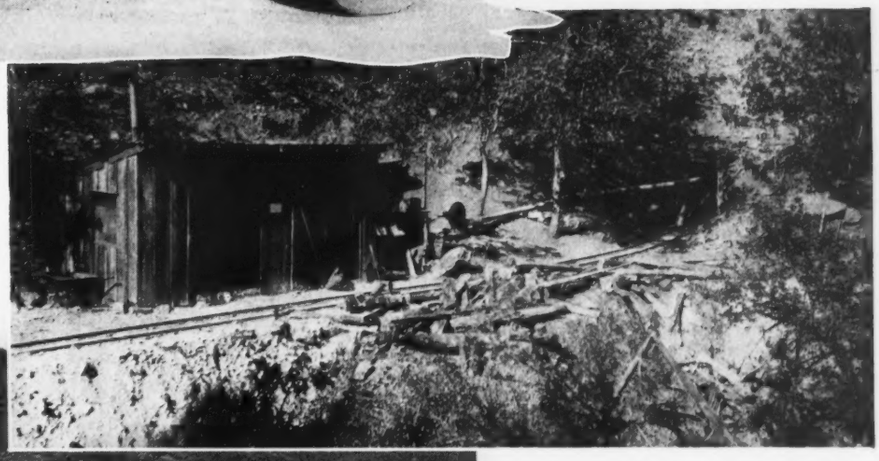


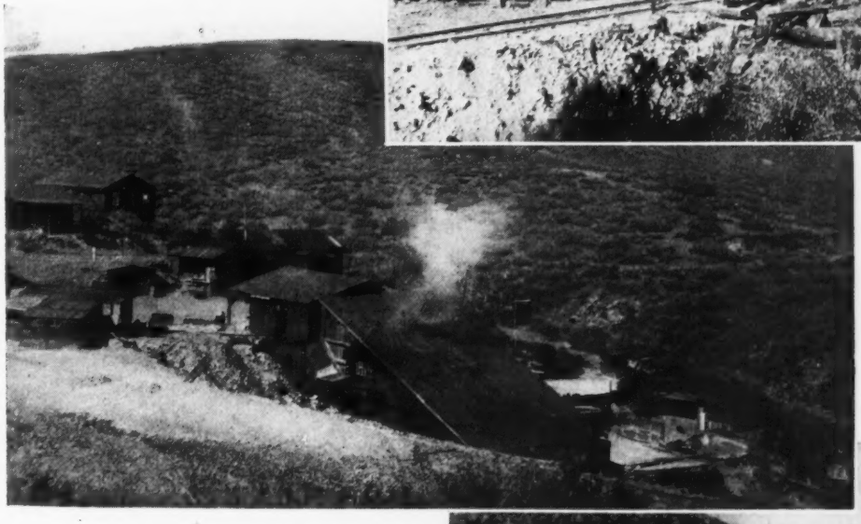
The Big Bug district and surrounding region

The old-timer with his "three b's"—burro, beans, and bacon—is giving way to the trained engineer and geologist. Fred Gibbs, manager for the Yavapai Silver Company, in the front seat, and two companions, are ready for the road in their Dodge car.



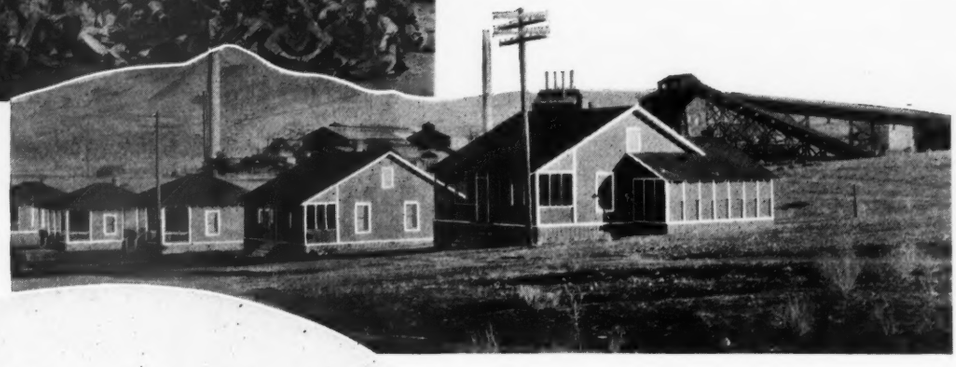
Right—Adit entrance at the Blue Rock mine of the Yavapai Silver Company, one of the likely prospects in the district.



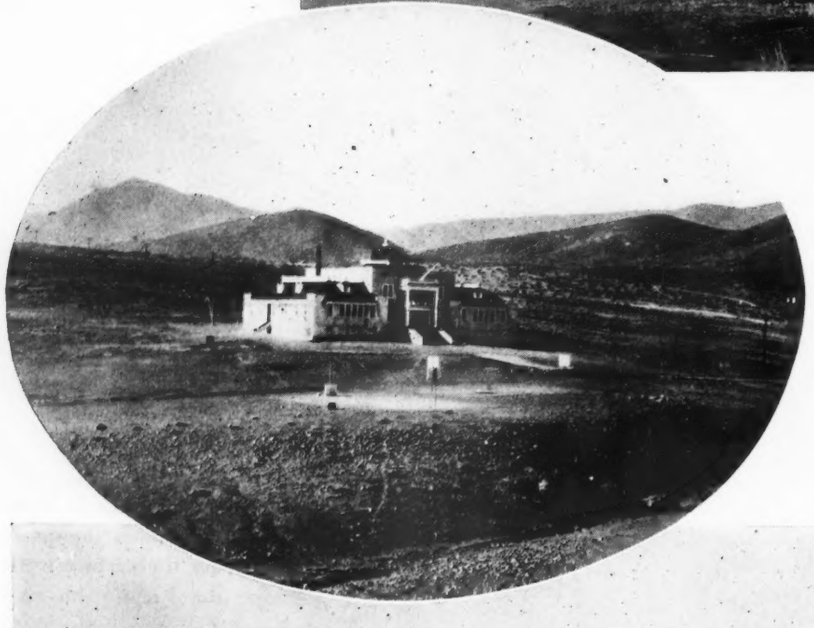


Left—Surface plant of the Arizona National mine on the Silver Belt vein. The small dumps on the hillside are the surface workings along the Kit Carson vein.

Right—Looking up Galena gulch at the surface plant of the Gladstone mine.



As they looked twenty years ago. Part of the day shift at the Gladstone-McCabe mine on April 11, 1906. *Below*—Dwellings of employees of the Humboldt smelter, which appears in the background.



Left—Looking toward the Big Bug district from the site of the Humboldt mill. The public school is in the center.

Below—The smelter and the town of Humboldt as seen from the siding of the Iron King mine.

make transportation so difficult in other parts of the state are almost wholly absent. Big Bug Valley is well wooded at the upper end, but the lower reaches are covered only with a low scrub oak and manzanita. Around Humboldt the land is mostly open grazing country.

Geology—The geology of this area was worked out and described some years ago by Jagger and Palache[1] and more recently by Waldemar Lindgren[2]. The predominating and oldest formation is the Yavapai schist, supposedly of sedimentary origin, in which are imbedded numerous lenses of quartzite. Intruded into the schists are tongues and areas of Bradshaw granite and a quartz diorite which appears as a marginal phase of the granite. The area is cut by many dikes of rhyolite porphyry and mineralized veins. Excluding the alluvial fills of the lower valleys, probably the youngest formation of the region is the basaltic flow which covers the top of Big Bug mesa, fragments of which may be picked up on the lower slopes and in the stream beds.

According to Lindgren the ore deposits belong to five classes:

1. Pyritic copper deposits in schists are represented by the Blue Bell, Hackberry, Butternut, Boggs, and other mines.
2. Pre-Cambrian quartz veins are represented by the old Mesa mine, near Poland, and probably by several veins near McCabe. The age of some of these is in doubt.
3. A gold-silver replacement deposit, the Iron King, near Humboldt, carries tourmaline and is of an unusual type.
4. Veins of later date, probably connected with the rhyolite dikes, are best exposed in the vicinity of Poland and Providence. The rich silver deposits with barite and calcite gangue, about 2 miles west of the Humboldt smelter, also belong to this group.
5. Placers have been worked in several gulches around McCabe.

It should be added that the flood plain of Big Bug Creek has been placered from its mouth almost all the way to Poland.

Big Bug Valley once contained thriving towns at Providence and Poland, and another just over the ridge at McCabe, but with the exception of a few ranchers and watchmen at mine plants which have not been dismantled the outlying districts are almost deserted. Humboldt, built around the Southwest Metals smelter, is the only center of population, but with Prescott and Jerome within easy distances over excellent state highways there is no difficulty in obtaining supplies.

With the exception of the Gold Leaf and the Yavapai Silver properties, both of which are still in the development stage, practically no work has been in progress in the district proper since the closing down of the Humboldt smelter more than a year ago. The area is highly mineralized, however, and the records of some of the old producers are sufficiently interesting to warrant a close investigation of their present possibilities. Rich pockets of secondary ore have been taken from the upper and oxidized zones of numerous veins in the district, but owing to the complex character of the primary ore, with one or two exceptions, little effort has been made to develop the deeper levels.

Iron King Mine—The nearest property to Humboldt is the Iron King, which is a little more than a mile west of the town. It was last operated under lease by the smelter company. The deposit is a replacement zone in the Yavapai schist along a rhyolite porphyry dike. Development at the property consists of two shafts about 700 ft. apart, which have been sunk to the 4th level. The orebodies are in the form of lenses, which sometimes overlap. Considerable diamond drilling has been done, and it is said that 20,000 tons of ore containing from $6 to $8 in gold and 4 to 25 oz. of silver is blocked out. Much of the surface plant has been removed since the mine was closed down and what remains is in bad repair.

Silver Belt Vein—Generally parallel with the dike on which the Iron King mine is situated and less than 2,000 ft. to the northwest is the Silver Belt vein. This vein falls in the fourth group of Lindgren's classification and has been a large producer. On it are located shaft No. 1 of Yavapai Silver, the old Silver Belt mine, the Arizona National, and the Lookout mines.

Yavapai Silver Company, Shaft No. 1—Less than half a mile west of the Iron King is the No. 1 shaft of Yavapai Silver. This shaft is at the intersection of the Junction and Silver Belt veins. It is down to a depth of 200 ft. and has several hundred feet of drifts at the bottom.

The surface plant, consisting of headframe, hoisthouse, compressor room, blacksmith shop, and change room, is about two years old and, with the equipment, is in excellent condition. Underground work did not develop any large amount of ore, and the operation was closed down because the company had ore in sight at another property. Indications are that the property may some day produce, and it is quite likely drifting will be continued at an early date.

Silver Belt—A little more than 3,000 ft. to the southwest, along the Silver Belt vein, are the old dumps of the Silver Belt mine. This property was located in 1870 and for some years was a large producer. Ore produced was packed to Ehrenberg and taken down the Colorado River. The property has seven shafts, the deepest reported as being 480 ft. down. However, drifting does not extend below the 250 level, and the richest ore seems to have been taken out much nearer the surface. The vein has a strike N. 30 deg. E. and a dip of 80 deg. toward the northwest. At this point the vein, which averages about 4½ ft. in width, is in the Yavapai schist, although it is close to the margin of an area of quartz diorite which lies to the west. Vein filling is composed of quartz, calcite, anchorite, and gouge. Mineralization consists of lead and zinc sulphides that have high silver content. The mine is credited with a production of more than $400,000. It has been worked for high-grade ore only, and it is reported that a large tonnage of mill ore was left in place and in the old stopes. An effort is being made to unwater the old workings to prove or disprove this report.

Arizona National—A small fractional claim, called the Smuggler, separates the Silver Belt claim from the Arizona National, situated to the southwest. This mine was first opened up as a prospect in 1914, and ore shipments were started almost at once. The property was operated continuously until about two years ago, when it was closed down because of the failure of a Prescott bank which tied up the working capital of the operators. It is credited with a total production of $233,000. Probably none of the zinc, of which the mill ore contained several per cent, was paid for. To eliminate the zinc, which was penalized by the smelters, a large proportion of the silver was lost in milling, so that the recorded production from smelter returns is much below the actual value of metals

[1]U. S. G. S. Atlas, Bradshaw Mountain Folio, No. 126, 1905.
[2]Bull. 782, U. S. Geological Survey, 1926.

taken out. The deepest of the two shafts is 520 ft. below surface. The bottom drift is at 500 ft., but there is quite a lot of undeveloped ground above this level. Although practically no ore reserve is blocked out, the mine is in condition for production.

Look-Out—On the next claim to the southwest of the Arizona National is the Look-Out mine. It has two shafts. No. 2 has a depth slightly over 200 ft. There are a number of short drifts running out from both shafts. A small mill was erected on the property in the fall of 1925, but owing to lack of water and poor financing, among other reasons, it was eventually closed down. There is said to be quite a lot of ore in sight. This property has two interesting features: first, sulphide ore is exposed in both shafts almost at the surface; second, the increase in arsenical pyrite and a proportional rise in the gold value to the southwest of the ore in the Silver Belt vein which becomes evident on this claim. The high-grade ore is reported to carry gold to the value of $2 to $3 per ton. This change in the character of the Silver Belt vein has led many to believe that it is a continuation of the Gladstone-McCabe vein system to the southwest.

Kit Carson Vein—Roughly parallel to the Silver Belt, but further to the northwest and converging with it to the northeast, is the Kit Carson vein. At the Silver Belt mine the distance between the outcrop of the two veins is about 1,500 ft. This vein is much wider than the Silver Belt, reaching in places a width of 20 ft. The upper and oxidized portion of this vein is literally honeycombed with old workings, and stories are current of the pockets of secondary ore rich in silver which leasers and operators have taken out of these workings. One small shipment of nine tons assayed 300 oz. of silver per ton. Most of the work has been done from tunnels driven on the vein from the numerous gulches which cut the vein almost at right angles. The Bowen mine, on the North Star claim, has a shaft down over 250 ft., with some drifting on the 250 level. The level is, however, still in oxidized vein matter, which gives an idea of the depth to which oxidation has taken place. The vein shows evidence of heavy mineralization throughout its exposed lengths and drifting at a depth sufficient to be in the sulphide zone may develop a considerable tonnage of mill ore containing enough silver-carrying galena to make a profitable operation.

Gladstone-McCabe—A little more than a mile southwest of the Look-Out and up Galena Gulch is the Gladstone-McCabe group, of five patented claims and one unpatented claim. The Sink-to-Rise claim was located in 1883 by Frank McCabe and the Gladstone by W. C. Parsons. Later a partnership was formed and other properties were added. The partnership paid from the first, and rich ore was taken out practically at the grass-roots. In 1900 the property was acquired by a New York syndicate, which organized the Ideal Mining and Development Company. In 1905 the adjoining property of the McCabe Mining Company was added to the group. The high point of production came between 1903 and 1907, under the lease and management of Cecil G. Fennel. The panic of 1907 and failure of the Humboldt smelter closed the Fennel operation. Since then serious work on the property has been undertaken only at intermittent periods and always on a small scale.

The gross value of ore sold from the property is only a little under $3,000,000, the values being in gold, silver, and copper.

Country rock in this vicinity is an amphibolitic schist. Veins occur near the border of a mass of quartz diorite. The Gladstone and McCabe veins are roughly 250 ft. apart. Development work centers around two shafts, which are about 800 ft. apart. The interesting feature of the situation is that the richest mineralization is in the neighborhood of a rhyolite porphyry dike which cuts across two veins halfway between the shafts. The Gladstone shaft is over 1,100 ft. deep and the McCabe slightly over 900. Development comprises several miles of drifts, of which the 1,100 level in the Gladstone is the lowest. The principal values, which are gold and silver, are carried in arsenopyrite, although sphalerite, galena, and chalcopyrite are also present. An interesting economic feature is that the combined lengths of oreshoots along the vein, as developed by the lower levels, amount to over 1,600 ft. If the property could have been worked under present-day methods, the profit to the owners would probably have been materially larger than that obtained.

Properties to the southwest of the Gladstone-McCabe are the Little Kicker, Rebel, and Gold Leaf. On the divide between Galena Gulch and Chaparral Creek are the Little Jessie, Dividend, Leland, and Union. Little Jessie and Union, which were worked together, have an accredited production of over $800,000.

Henrietta Mine—On a saddle in the watershed between the Gladstone-McCabe mine and Big Bug Creek are located the Gold Arrow, Gopher, and Henrietta mines. Gold Arrow is only a prospect. Gopher, when last operated, was combined with Henrietta. Henrietta was first developed by a shaft in the top of the hill to a depth of 500 ft. Two tunnels have been driven in from the Big Bug side of the divide, the lower one being 2,200 ft. long. A winze or shaft sunk from near the inner end of this tunnel extends to a depth of 600 ft. The mine is an old-timer, dating back to 1882. Excepting for the operations of small lessees, the property has been idle since 1922. No total production figures are available, but ore shipped is said to have assayed from $8 to $10 in gold and 5 per cent copper.

Traveling up Big Bug Creek from Henrietta one passes a number of properties, including the Sterling, Fortuna, Red Rock, Postmaster, Merchant's Home, Copper Dike, and Lottie. Most of these properties were worked for their gold-copper ores. Except for assessment work on the many claims and prospects in the area, little development is taking place. The town of Providence has practically passed out of existence.

Poland is in a somewhat better position, as it is at railhead on the Big Bug spur of the Santa Fe and at the entrance of the Poland tunnel. Poland mine, developed by the Poland tunnel, has an accredited production of $750,000, most of which probably was silver. Other properties in the neighborhood are the Express, Fitz Hugh Lee, Money Metals, and Blue Rock. Money Metals is being reopened. Development work at Blue Rock has been pushed during the last few months by the Yavapai Silver Company. The property is a new one, and so far the work done has produced very promising results. If the tunnel, which is now in 280 ft., develops the ore expected, a crosscut tunnel will be driven from the old Fitz Hugh workings to cut the Blue Rock vein 237 ft. below the present workings.

Poland tunnel is of interest principally because it is the outlet to the Sheldon and other mines, located in the upper end of the Walker district. The Sheldon stopped production about six months ago to enlarge its shaft down to the 1,150 level and sink another 500 ft. It is reported that this work is progressing.

Below the Henrietta on the Big Bug are the Boggs, Iron Queen, Hackberry, Butternut, Pocahontas, and Blue Bell mines. The Blue Bell, which has been a large producer for a number of years, was operated up to the closing down of the Humboldt smelter, less than a year ago. The mine has been developed and largely worked out down to the 1,200-ft. level. Total production has been about 1,000,000 tons of ore shipped, having a gross average value around $10 per ton, for the most part in gold and copper.

This district, like many others, has its legends and its old-timers. Some of the most interesting characters have passed the Great Divide during the last year, some are in the Miner's Home in Prescott; others are still out in the hills keeping up their assessment work on newly staked claims. When the warm days come in March and the air is heavy with the smell of the manzanita blooms, these old fellows get out and poke around the hills, hoping to uncover a "strike." It is not, however, to their kind that the future of the district must look for its rehabilitation, but to the geophysical prospector and the college-trained flotation expert.

Disk Crushers—
Their Development and Advantages

By W. T. W. MILLER

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THE REMARKABLE SERIES of machines known as disk crushers owe their inception to the Symons Brothers, and in particular to the genius of Edgar B. Symons. Their outstanding feature is the utilization of centrifugal force as a means of spreading the material quickly and evenly over the crushing faces and of preventing packing when set for fine crushing.

In the disk crusher the crushing faces take the form of a pair of saucer-shaped disks revolving at equal speed in the same direction, one disk traveling in a fixed plane, while the other advances and recedes under the influence of a series of crushing waves or impulses. The disks are set with their concave faces opposite, and the material to be broken enters the crushing cavity through a hole in the center of one of the disks, and is spread evenly over the surfaces by the action of centrifugal force.

Theoretically, the shape of these crushing surfaces approaches the ideal in that the ratio of inlet area to exit area is more nearly equal than in any other form of secondary breaker. In other words, for a given length of travel from nipping point to outlet point, the material has more room to spread sideways under the crushing action than in any other breaker with confining faces.

The machines are now constructed of two distinct types, which may be divided for classification under the headings of horizontal and vertical disk crushers. It should be made clear that the terms "horizontal" and "vertical" have reference to the position of the axis of the machine and are not intended to apply to the position of the disks. In the horizontal disk crusher, the axis of the main shaft is horizontal and the disks are vertical, and in the vertical machine these conditions are reversed.

With some modifications, the horizontal crusher represents the machine in its earliest form, the vertical type being introduced at a later date as a fine-reduction crusher, although more recently the vertical machines have encroached somewhat on the field of the earlier crushers.

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Fig. 1 shows the disk crusher in its original form, as introduced about 1908. A hollow shaft was supported in two bearings carried on a frame or bedplate. One end of this main shaft was enlarged to form the cup-shaped seating for a semi-spherical bearing which was pressed on a taper shaft free to move independently inside the bore of the hollow shaft. The outer disk, with central hole to permit of entry of the material to be crushed, was attached to a circular back plate connected by distance pieces to an angle ring with the internal threads corresponding with the screw formed on the outside diameter of the flange on the hollow shaft. The inner disk was secured by a strong countersunk setscrew to the inner shaft and semi-spherical bearing, and the inner shaft was lengthened to project through the hollow shaft at the opposite end of the disk. A flanged sleeve, with a feather key, was fitted over the projecting end of the taper shaft in such a manner that the flange could be brought to bear on the end of the hollow shaft when the lock nuts were screwed against the narrow end of the sleeve. This tightening device had the effect of keeping the ball end of the inner shaft close against the socket in the hollow shaft, and the end of the hollow shaft was made spherical to a radius struck from the center of the ball, the flange being cupped to correspond, so as to insure freedom for sideways movement.

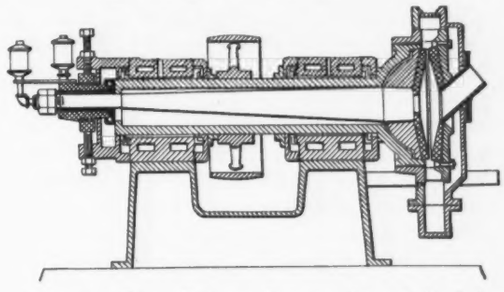


Fig. 1—The disk crusher in its original form as introduced about 1908

Before explaining the mechanism further, the essential features of the combination of parts as already described should be understood. These consisted of two saucer-shaped disks, one semi-rigidly connected to the flange of the hollow shaft, the other secured to the ball end of the inner shaft in such a way as to be free to move inside a closed chamber within the limits imposed by the clearance between the interior of the hole in the hollow shaft and the outer surface of the inner shaft.

Suppose, for a moment, that no rotary movement is

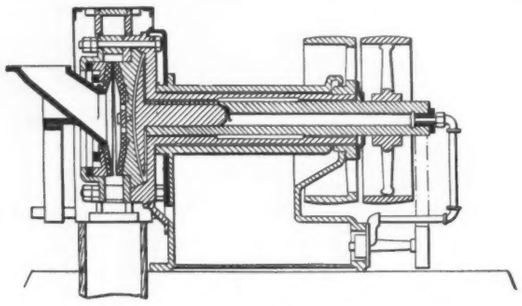


Fig. 2—The disk crusher as modified in 1910, and, in most essentials, as the horizontal disk crusher is today

given to the parts, but that, while the machine is standing, the free outer end of the inner shaft is made to move up and down. The position of the inner disk, at right angles to the axis of the inner shaft, would transform this vertical movement into a horizontal crushing stroke.

It will be seen that any force applied to the sleeve at the outer end of the inner shaft would react on the inner disk with a leverage corresponding to the ratio between the radius of the disk and the length of the shaft from center of semi-spherical bearing to center of sleeve.

In the earliest form of disk crusher, as shown in Fig. 1, the sleeve on the end of the inner shaft was supported in an adjustable bearing in which it was free to rotate and by means of which the inner shaft could be set at a variable angle to the axis of the hollow shaft. The hollow shaft was rotated by means of a central belt pulley, causing the outer disk to revolve in a vertical plane, and the friction of the ball and socket bearing, supplemented by the wedging action of the material contained within the crushing cavity, caused the inner shaft and disk to revolve at the same speed and in the same direction.

Owing to the inclination of the inner shaft, the crushing face of the inner disk remained at a constant angle with the face of the outer disk, giving a variable aperture with the minimum opening in a fixed position in line with the eccentricity of the bearing for the sleeve. Material entering the space between the disks was gripped at the point of maximum opening and carried round by and with the disks to the nipping point, being subjected to a crushing stroke for one half and a freeing stroke for the other half of each revolution.

The speed was sufficient to cause a spreading action due to centrifugal force, and the crushed material was thrown outward, past the spacing bars between the angle ring and the back plate for the outer disk, into a collecting channel formed in the hood or stationary casing by means of which the product was brought to a central outlet. This machine gave only one crushing stroke per revolution, and this nip was concentrated in the one position. To obtain effective crushing it was necessary to run the hollow shaft at a relatively high speed, and the bearings for the main shaft were water-cooled, provision also being made for force-pump lubrication.

Although proving the effectiveness of the principle involved, the machine, as shown in Fig. 1, had several defects: Since the eccentricity could be varied at will, giving a considerable range of crushing strokes, the movement could be quickly changed in unskilful hands so as to cause serious overstrain to the working parts of the crusher. Also, as the maximum outlet aperture between the disks was fixed in one position, the discharge was concentrated at one part of the annular channel inside the hood.

In 1910 Messrs. Symons modified the crusher as shown in Fig. 2, and in all essential features, with the exception possibly of the means for adjusting the disks, this figure represents the horizontal disk crusher as now made. In the new design an important change was made in the method of applying the crushing force to the inner disk. An extension piece was bolted to the end of the main frame, and a pulley with an eccentric boss was fitted over the sleeve on the outer end of the inner shaft. The pulley boss was supported by the bearing attached to the frame. The lock nut on the end of the inner shaft was provided with a flange projecting beyond the end of the sleeve and partly covering the end of the pulley, so that the pulley could not slip out of its bearing. It should be clearly understood that this eccentric pulley was not attached to the inner shaft in any way, and that any circular movement of the pulley caused the shaft to gyrate without rotation.

Reverting to the description of the movement in the earlier machines, and assuming once more that the hollow

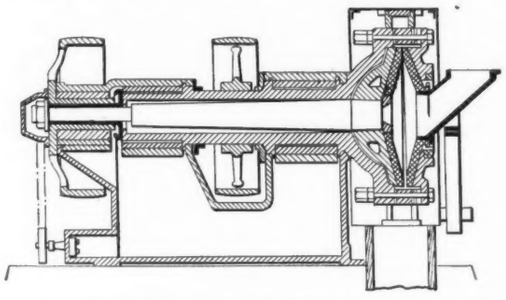


Fig. 3—A modification of design made to relieve the shims from crushing pressure

shaft and inner shaft were held against rotation, it will readily be seen that each revolution of the eccentric pulley caused the outermost end of the inner shaft to gyrate in a circular path, which, in turn, transmitted a wave movement to the surface of the inner disk, this movement consisting entirely of side displacement without revolution.

When the eccentric pulley was standing idle and the hollow shaft rotated, the motion was in all respects similar to that in the earlier machine, one circular crushing wave being developed for each revolution of the disks. When the eccentric pulley was made to revolve at the same speed as the main shaft, but in the opposite direction, two crushing waves were obtained for each revolution of the disks; in other words, the number of crushing strokes was equal to the revolutions of both pulleys added together. With this form of construction it was possible to reduce the speed of the main shaft, and with it the revolutions of the disks, to the limit imposed by the centrifugal force necessary to give perfect spreading of the material between the crushing faces. Without impairing

the crushing efficiency, this reduction in speed made water-cooled bearings superfluous, and the machine was therefore simplified by their removal.

The only other change in construction was in the system of adjusting the disks. The containing ring for the outer disk was secured to the flange of the hollow shaft by distance pieces and bolts, and the disk was clamped to a separate circular plate sliding inside the outer casting. The disk plate was secured to the outer ring by setscrews passing through packings or shims which could be varied in thickness to change the position of the disks. This adjustment was used to vary the size of the finished product; also to compensate for wear on the disks.

Under continuous and heavy work the reaction from the crushing pressure caused the shims to beat into the surface of the seating and, in some cases also, the packings were irregular in thickness, creating a rocking or rolling movement on the back plate which made it difficult to keep the setscrews tight. To remedy this, the larger machines are sometimes made with the shims arranged as shown in Fig. 3. In this design distance washers are placed between the ferrules covering the tiebolts and the outer disk plate. In this position they are not affected by the crushing pressure, but, when it is desired to alter the setting of the disks, the main tiebolts have to be released and it is not so easy to ensure true running of the outer plates which overhang on the bolts.

The horizontal disk crushers are now made in four sizes, 18 in., 24 in., 36 in., and 48 in. In each size the figure given is the outside diameter of the disk. These machines are specially designed for the work of intermediate crushing, and they cannot be set for a product finer than ½-in. ring, which can be obtained only from the smaller crushers. The limitations of the four machines are as follows:

Crusher size	18 in.	24 in.	36 in.	48 in.
Maximum feed size	1¾ in.	2½ in.	4 in.	7 in.
Finest product	¼ in.	⅜ in.	1 in.	1¼ in. ring

It should be noted that the dimension given represents the thickness of the pieces of stone. Slabby stones up to twice this length will feed quite readily.

In 1911 Messrs. Symons constructed one or two trial machines with the mechanism shown in Fig 4. The combination of the eccentric, lever shaft, and spherical bearing was abandoned in favor of an eccentric and floating

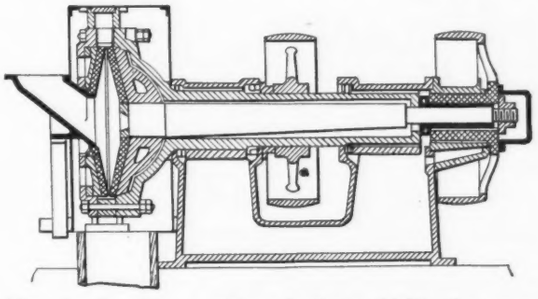


Fig. 4—In this machine, built in 1911, the combination of eccentric, lever shaft, and spherical bearing was abandoned in favor of an eccentric and floating wedge

wedge. The hollow shaft, with flange at one end to which the carrier plates for the outer disk were bolted, was made on similar lines to the standard crusher except that the cup-shaped seating was replaced by a circular flat surface.

Frame bearing was continuous, and the main shaft driving pulley was keyed to the end of the shaft instead of near the middle. A long, hollow spindle driven by a second pulley revolved in bearings in the bore of the outer shaft. At the disk end, this spindle was bored eccentrically and lined with babbitt metal to form a bearing for the stem on a mushroom-headed floating wedge.

The back plate supporting the inner disk was held loosely in the recess in the flange of the hollow shaft by an overlapping ring of washer plate secured by the main tiebolts holding the outer disk. Fastening was so arranged that the inner disk with its backing was free to move to a limited extent in a horizontal direction, but could not fall out of the recess in the hollow shaft. The outer surface of the mushroom head on the ball wedge was part spherical and the back plate for the inner disk was curved to correspond. The under surface of the mushroom was made flat to bed on the seating in the hollow shaft.

Following a similar train of reasoning to that outlined previously, and assuming that the outer shaft was revolved while the inner sleeve or spindle remained stationary, friction caused the disks to turn together and with them rotated the mushroom-headed wedge. As this wedge was out of center with the axis of the disks, its displacement in relation to the spherical seating of the back plate caused the inner disk to be inclined to the crushing surface of the outer disk. Rotation of the disks made every point on their peripheries pass the stations of maximum and minimum opening once per revolution.

When the inner eccentric sleeve was revolved, the head of the wedge gyrated in the cavity between the flange and back plate, transmitting an undulatory movement without rotation to the inner disk.

From this description it will be seen that, when the two pulleys were rotated in opposite directions at different speeds, the revolutions of the disks were limited by the speed of the hollow shaft, but the number of crushing waves was equivalent to the revolutions of both pulleys added together. The resulting crushing movements were therefore exactly similar to those obtained from the machine illustrated in Fig. 2.

In this form the machine was not entirely satisfactory. When the crusher was running light there was no force insuring contact between the head of the floating wedge and the bearing surfaces of the back plate and hollow shaft, and, when crushing intermittently, some hammering on the bearing faces was likely to occur, so that the combination did not appear to compare favorably with the lever-shaft type.

To be concluded

Molybdenum Production Increased In 1927

Three companies produced molybdenum ore in the United States during 1927, Climax Molybdenum, at Climax, Colo., Molybdenum Corporation of America at Sulphur Gulch, near Questa, N. M., and Santa Niña Mining, at Helvetia, Ariz., according to data collected by the U. S. Bureau of Mines. A total of 216,595 short tons of ore was milled, from which concentrates carrying from 75.14 to 95.4 per cent of molybdenum sulphide, MoS_2, equivalent to 2,299,217 lb. of elemental molybdenum, were obtained—an increase of about two-thirds over 1926. Of the concentrates produced 2,286,075 lb., valued at the mines at $1,858,786, was shipped.

Reduction Roasting, Leaching, and Electrolytic Treatment of

Bolivian Tin Concentrates

Last of a Series of Six Articles Based on Physico-chemical Studies in the Metallurgy of Tin

By C. G. FINK and C. L. MANTELL

Respectively, head, Division of Electro-Chemistry, Columbia University; and consulting chemical engineer, Pratt Institute, Brooklyn

ONE OF the methods that have been proposed for the winning of tin from Bolivian concentrates consists of the following steps:

1. Reduce the concentrate by gaseous reduction.
2. Leach the reduced concentrate with a solution low in tin. It is preferable that this solution be a good electrolytic refining agent.
3. Electrolytically precipitate the tin metal under controlled conditions, so that "electrolytic tin" of high purity be obtained.
4. Re-use the electrolyte now stripped of some of its tin for leaching fresh, reduced concentrate. The electrolyte then operates in a closed cycle.

Commercial practice prefers a cheap, simple and economical refining electrolyte. These conditions are satisfied by the sulphuric acid-sodium sulphate-stannous sulphate bath.[1]

An experimental series of runs was made to determine whether the refining bath could be modified to make it an effective and a rapid solvent for tin. Samples were made up of 100 c.c. each in oil sample bottles. The bottles were stoppered and mechanically agitated for two weeks on the same machine used later for dissolving experiments. After two weeks, the samples were analyzed for tin by filtration, reduction with zinc, and titration with iodine solution standardized in terms of tin. All determinations were made at 20 deg. C.

Check samples were made of 10 grams of chemically pure granulated tin in 100 c.c. of 15 per cent sulphuric acid. After two weeks, analysis showed a tin concentration of 0.38 grams per liter. These were allowed to stand for two months and again analyzed. The tin concentration was then 0.40 grams per liter.

Another set of samples was made with 10 grams stannous sulphate, 10 grams tin and 100 c.c. 15 per cent sulphuric acid. After two weeks' agitation the tin concentration was 2.98 grams per liter.

A third set, each bottle in duplicate, was made up of 10 grams stannous sulphate, 10 grams tin, 100 c.c. of 15 per cent sulphuric acid, and various additions of sodium sulphate. The additions of sodium sulphate in the different bottles were 0.25, 0.50, 1.0, 2.0, 5.0, 10.0, 15.0, 20.0, and 25.0 grams to 100 c.c. of 15 per cent sulphuric acid solution. After two weeks' agitation the solutions were analyzed and the results plotted. The curve for the effect of sodium sulphate on the solubility of tin is shown in Fig. 1.

[1]U. S. Patent 1,466,126.

A fourth set of solutions was made up of 10 grams tin, 10 grams stannous sulphate, 100 c.c. of water, and various additions of glauber's salt (Na_2SO_4 $10H_2O$). These additions were 5, 10, 15, 20, 30, 45, 50, and 60 grams per 100 c.c. of water in the bottle. After two weeks' agitation, the solutions were analyzed and the tin concentration was plotted against the glauber's salt concentration. The curve is shown in Fig. 2.

A fifth set of solutions was made up of 10 grams tin, 10 grams stannous sulphate and 100 c.c. of 15 per cent

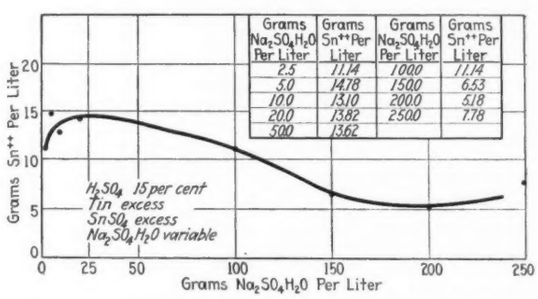


Fig. 1—Effect of sodium sulphate in solvent

sulphuric acid with varying additions of sodium chloride. The sodium chloride was added in concentrations of 0.25, 0.50, 1.0, 2.0, 4.0, 5.0, 10.0, and 15.0, grams per 100 c.c. of 15 per cent sulphuric acid. After two weeks' agitation, these solutions were analyzed and the tin concentration was plotted against the sodium chloride concentration. The curve is given in Fig. 3. The effect of sodium chloride on the tin solubility is quite marked.

SULPHURIC ACID AND SODIUM CHLORIDE MAKE SOLVENT

Leaching solutions which have the possibility of being good refining baths are limited in number. Additions of sodium sulphate to 15 per cent sulphuric acid do not markedly increase its solvent power for tin, although the sulphate may decrease hydrolysis of tin salts in solution. The best conditions for the tin refining bath call for a tin concentration of 35 grams per liter. Additions of sodium chloride to 15 per cent sulphuric acid increase its solvent power sufficiently to obtain this concentration.

A satisfactory leaching solution for tin metal, and therefore presumably for reduced tin concentrates, contains 15 per cent sulphuric acid and 5 per cent sodium chloride.

Work on 10-gram samples of tin concentrate, reduced by hydrogen, showed that all of the reduced metal was quantitatively soluble in hydrochloric acid or sulphuric acid plus sodium chloride. Low-temperature reduction, reported in a previous paper, could be complete and the tin metal produced could be completely recovered. On small samples, at least, 100 per cent metal recovery (in solution form) from the ore can be obtained.

Leaching of Reduced Tin Concentrates

Ten-gram samples of reduced concentrates digested for one-half hour in 250 c.c. of a leaching solution of 150 grams sulphuric acid per liter and 50 grams sodium chloride per liter showed complete solubility of the tin metal. The gangue remaining, upon microscopic examination, was very clean. It was washed, filtered, dried, and reduced by hydrogen at 750 deg. C. for two hours. Examination of the reduced material for tin by chemical methods showed no positive tin test.

Two kilograms of reduced tin concentrate was made by reduction with hydrogen. Only slight rabbling with a rod was given. The rabbling was only slight, so as not to cause the tin particles to run together too much but still expose fresh ore surfaces. After cooling, the reduced concentrate was examined. The tin metal was largely in the shape of small pellets about the size of bird shot or small bullets. The reduced concentrate analyzed 85 per cent tin, and 5.2 per cent iron. Charges of 250 grams were digested for six hours with four liters of a solution containing 150 grams sulphuric acid and 50 grams sodium chloride per liter, the reduced concentrates being mechanically stirred into the solution during this test period. Practically complete solution of the metal values took place. Considerable iron was dissolved, as was shown by the color of the solution. The solution was filtered through acid-washed asbestos; the gangue washed, dried, reduced in hydrogen, and tested for tin. Only a faint tin test was obtained. The solution analyzed 52.8 grams tin per liter. It was electrolyzed between graphite anodes and brass cathodes at a current density of 10 amp. per square foot. After 10½ hours, with 10 amp. through the cell, the tin metal deposited weighed

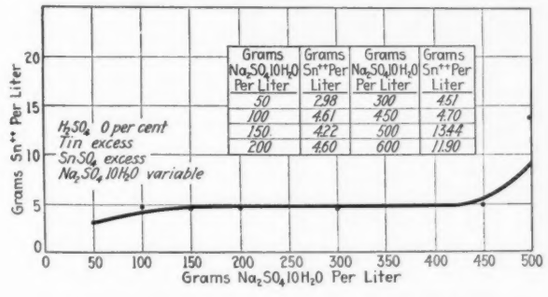


Fig. 2—Effect of glauber's salt in solvent

approximately 167 grams and the solution contained 11.8 grams per liter. There was 3,700 c.c. of solution remaining, giving a net total of 43.7 grams of metal in solution. Voltage across the tank during electrolysis varied from 0.3 to 0.8. The tin metal deposit was decidedly crystalline. The electrolyte was removed from the cell and 4,300 c.c. of new leach liquor added to it. Then the total of eight liters (5.46 grams tin per liter) was used to leach a ½-kg. charge of reduced concentrates over a 12-hour period. Solution ran 56.2 grams tin per liter. It was electrolyzed as before with 20 amp. through the cell for 11 hours, approximately 370 grams of metal being deposited. The 7,600 c.c. of solution remaining ran 10.2 grams tin per liter, or a total of 77.5 grams. The tin deposit was decidedly crystalline and not very adherent.

Releaching the gangue material with 2 liters of fresh

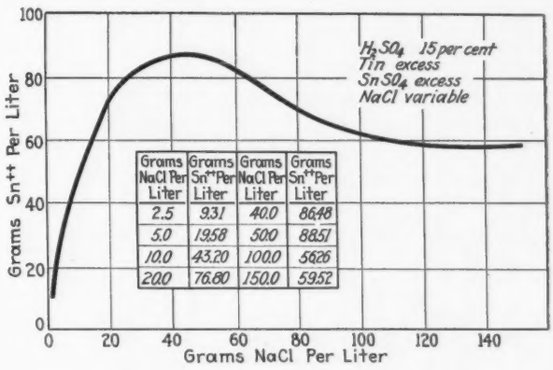


Fig. 3—Effect of sodium chloride in solvent

solution gave a tin concentration of 7.4 grams per liter, or a total of 14.8 grams of tin. The 750 grams of reduced concentrate contained 637.5 grams of tin metal. There were recovered 537 grams of tin as cathode deposit metal and 92.3 grams in solution in recoverable form. The sum of these represents better than a 98 per cent recovery of the tin in reduced concentrates. Since the concentrates lost none of their tin values in reduction, the figure represents a 98 per cent tin recovery on the basis of the original unreduced concentrates.

Recoveries Up to 98 Per Cent

Additional check leachings were made in the same manner with tin recoveries from 95 to 98 per cent. This work was not carried further, as the results obtained would mean little save as indications as to what might be expected in practice. There is little doubt that with counter-current leaching and continuous electrolytic precipitation of metal and re-use of leach liquor, tin recoveries higher than 96 per cent are entirely possible. Of course, iron will build up in the leach liquor, with the resultant necessity of constantly bleeding some of the liquor. Bismuth, copper, and other metals would also build up in plant operation.

Leaching efficiencies would depend upon many factors, such as size, type, shape of apparatus and method of leaching. Higher metal recoveries than those obtained from smelting are to be expected, as the operation consists of leaching a loose, sandy mass containing more than 80 per cent of an easily acid-soluble metal.

It was desired to determine whether reduced tin concentrates might be leached in place with simultaneous deposition of the metal electrolytically. A 1½ kg. charge of 68 per cent Bolivian concentrate was packed into a ¾-in. wrought-iron pipe, 48 in long. Thirty inches of the pipe was heated by electric furnaces to temperatures from 400 to 500 deg. C. and maintained at these temperatures for 48 hours. Hydrogen gas at from 5- to 10-lb. gauge pressure was passed through the mass, which gave a gas flow through the bubble bottle at the end of 3 to 4 liters of excess hydrogen gas per hour, or the equivalent of 1 c.c. per second.

One hundred grams of reduced tin concentrate (85 per cent tin) was used as the charge. Reduced ore was

piled up on a graphite block anode submerged in a sulphuric acid-sodium chloride electrolyte. This electrolyte contained 100 grams sulphuric acid and 50 grams sodium chloride per liter.

The cathode was of sheet brass suspended parallel to the anode, arranged as shown in Fig. 4. The clay jar

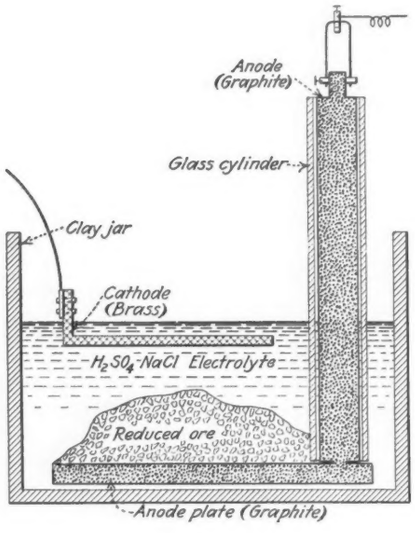


Fig. 4—Arrangement of apparatus for simultaneous leaching and electrolytic deposition

container was 7 in. in diameter and 5 in. high; the brass cathode 3 by 2 in. of 28 B. & S. gage sheet; volume of solution used was 2.2 liters.

Deposits of tin metal obtained were black and tended to grow spongy and slimy. Despite the fact that the solution was acid and that tin usually deposits from such solutions as needle-like crystals, at no time were any needles or crystals produced.

On the first run, 0.15 amp. was passed through the bath for thirty days, or a total of 108 amp.-hr. Voltage varied from 1 to 3 over this period. From stannous solutions tin is deposited (at 100 per cent current efficiency) at the rate of 2.2 grams per ampere-hour. From stannic solutions the yield would be half of this figure. Largest possible yield would be $108 \times 2.2 = 237.6$ grams, assuming a stannous solution. The tin metal weight produced was 10.3275 grams; a current efficiency of 4.4 per cent. This low current efficiency was attributable to concentration polarization at the beginning of the run, slow chemical solution of the reduced tin ore, poor electrical contact, and energy losses of the reduced tin particles with the anode due to anodic oxidation and cathodic reduction of iron in the ore (the iron oxides had also been reduced to metal), deposition, and liberation of chlorine. The odor of chlorine was quite evident during the latter part of the run. Agitation was not possible, as this would have caused slimy, muddy solutions resulting from stirring up the gangue of the ore. Two additional 30-day runs with all conditions the same as in the first run resulted in 5.75 per cent and 6.1 per cent current efficiency calculated on the same basis. These results would not seem to hold out hope for a commercial process which would leach reduced ore in place with simultaneous electrodeposition.

Tin ore reduced with hydrogen, from which the tin was leached by solutions of sulphuric acid and sodium chloride, gave good yields with carbon anodes and brass cathodes. The tin deposits were good clean crystalline metal, bright in color. By the combination of low-temperature reduction, leaching at room temperatures, and electrolytic precipitation, the metal yields ranged from 95 to 98 per cent without difficulty. Precipitation was continued until the tin content was reduced to 10 grams per liter. Solutions with low tin content were used for leaching freshly reduced ore.

Leaching with agitation separately from electrolytic precipitation is decidedly preferable to leaching and electrolytic precipitation at the same time. The first method gives very much higher yields, at higher current and energy efficiencies, with the production of better cathode deposits. The metal is more compact, is better looking, and is more easily handled.

Gangue from the leaching treatment was clean. Under a microscope it showed quartz, garnet, and tourmaline. There was no fusion of the tourmaline at the temperatures at which the gaseous reduction took place. The temperature of operation is such as to eliminate entirely the problem of the low-fusing constituents covering over the particles of cassiterite and prevent the reducing gas from coming in contact with the material, thus not allowing its reduction to metallic tin.

Résumé of Six Articles

The belief that solid carbon is the active reducing agent in the reduction of metallic oxides has won considerable acceptance. The results of our experimental work on stannic oxide do not allow us to accept this view. They show that stannic oxide is reduced by carbon only as the result of its oxidation to carbon monoxide. The reduction is, therefore, gaseous in its mechanism. Stannic oxide has an exceedingly low vapor pressure, even at temperatures as high as 1,400 deg. C.

Literature on tin metallurgy is very sparse. The outstanding book, and practically the only one, in the field is that of Louis, "Metallurgy of Tin." (McGraw-Hill Company, 1912.) Louis' book is a reprint of a series of articles published by him in *Mineral Industry* during 1896. Wilhelm Borchers in *Band* IV "Metallhüttenbetriebe (William Knapp, Halle, 1924), discusses tin, bismuth, and antimony. Most of the work in Borchers' book is strikingly similar to Louis or Menniecke, another German author, who wrote his "Metallurgie des Zinns" in 1910.

Data have been lacking on the reduction rates of stannic oxide by hydrogen. Curves for the reduction rates at various temperatures are given for the first time. They are the result of a large amount of experimental work. There has been no published work on gaseous reduction of tin concentrates showing the effect of grain size or of temperature until our own work. And no attempt has previously been made to report the results of a comprehensive study of the gaseous reduction of tin concentrates.

Owing to the fact that cassiterite was universally accepted as being exceedingly insoluble, no account has been published of work which was done with a view to determine whether a process might be developed for leaching tin ore analogous to the well-known hydrometallurgical process for copper, zinc, and iron. Results obtained are not promising for such a process at present. It is the writers' belief that such a process will some day come into existence.

Koeberlein (*Engineering and Mining Journal*, Vol. 121, p. 636, 1926) deplored the fact that there were no published data on the solubility of cassiterite. Our work

has furnished considerable information on this point. This may serve the geologist as data in support of theories pertaining to the formation of secondary tin-ore deposits. Geological knowledge has advanced beyond chemical knowledge. No chemical investigations other than chance experiments, to confirm the solubility of cassiterite, have been made. The statement that cassiterite is soluble in concentrated sulphuric acid has persisted in the literature. Chemical handbooks give this data even today. Our work shows this statement to be incorrect. Original reference shows that the statement was credited to Ditte (*Ann. de Chimie et Phys.*, Vol. 27, p. 162). Careful reading of Ditte's report shows that his statement does not agree with his experimental evidence and that workers following him have misinterpreted his original statement and omitted careful consideration of his experimental data.

It has usually been assumed that oxides of tin were more readily reduced to metal than were the oxides of iron. A careful study of the oxidation of tin and iron metals produced by gaseous reduction has been made. When these data are coupled with the comparative rates of reduction of iron oxide and stannic oxide, the conclusion that tin oxides were more readily reduced than iron oxide is demonstrated to rest on an unsound basis. We believe that these studies fully explain the non-appearance of metallic iron in many cases in the masses resulting from the concentrates reduction.

Except for the original observation of Goldschmidt, there has been a scarcity of work on the reduction of cassiterite by aluminum. This method may be useful in remote regions where small deposits exist. Although good metal yields are obtained, the cost is too high to be profitable.

Wells, in 1890 (*Columbia School of Mines Quarterly*), proposed zinc and hydrochloric acid as a means of dissolving cassiterite for analytical purposes. The zinc when in contact with the particle of cassiterite reduced it as a result of the hydrogen generated. This is the present-day field test. An investigation of the possibility of commercial development of this phenomenon shows that the energy efficiency of the process is so low as to make the idea impracticable.

Chloride Ion Factor in Solubility

Tin metal has been known not to be readily soluble in sulphuric acid. As a result of studies on the solubility of tin metal and the various constituents of a sulphuric acid tin-refining bath, the important effect of chloride ion addition on the tin solubility has been shown.

It is believed that gaseous reduction of tin concentrate offers great promise. Slag troubles are eliminated. Refractory troubles are not in evidence. Formation of hardhead is decreased. The operation is one of low temperatures (750 deg. C). Using hydrogen generated by electrolytic means and electrical heating, the total power requirements are 1,930 kw.-hr. per ton of 60 per cent concentrate.

The combination of gaseous reduction, leaching the reduced charge, and electrolytically precipitating the tin metal offers a cheap method of dealing with foul Bolivian ore with the production of tin metal of 99.98 per cent purity. It is believed that tin recoveries (95 per cent or better) are possible by this combination of steps. The cost to produce "electrolytic tin" from a ton of 60 per cent Bolivian concentrate is estimated, with power at $0.01 per kw.-hr. to be about $20.14 per 1200 pounds of metal, or $35.40 per ton of finished metal. This is based on 1030 kw.-hr. for hydrogen production per ton of 60 per cent concentrate, 900 kw.-hr. for heating to 750 deg. C., and 144 kw.-hr. per ton of tin to be refined electrolytically at 0.3 volts, 85 per cent current efficiency, at 10 amp. per square foot. This cost compares exceedingly well with carbon reduction smelting costs at $40 to $50 per ton of 60 per cent concentrate. With cheaper hydroelectric power, say at $0.003 per kw.-hr., the cost for hydrogen reduction, leaching, and precipitation would be approximately $6.05 per ton of 60 per cent concentrate.

Smelters can handle foul Bolivian ores only with great difficulty. Without electrolytic refining it is difficult even to produce "standard" metal. Hydrogen reduction, leaching, and electrolytic precipitation offers a cheaper method, with greater ease of operation; moreover, it is capable of producing the highest grade of metal from complex and foul ores.

Aerial Photography in Northern Rhodesia

IN PREPARATION for the aërial photographic survey of the property of the Rhodesia-Congo Border Concessions, Ltd., aërodromes were built and emergency landing places cleared at intervals 20 miles apart to insure the safety of the pilots and photographers, according to the report of C. B. Kingston, consulting engineer for the company in Northern Rhodesia. Two aërodromes were constructed, one at N'Changa and one at Lusemfwa. At the former place a steel and galvanized iron hangar to house two planes was erected and a special building for the development and printing of the photographs. Houses for the personnel were also built.

Preparation of the emergency landing places proved to be more difficult than expected, owing to the ubiquity of the giant ant heaps that are such an amazing feature of the country. The removal of these obstructions proved more difficult than clearing away forest trees. Forty-three such landing places were prepared and many of them had to be cleared a second time before the actual flying began, owing to the rapid growth of heavy grass, which is even more dangerous to landing airplanes than many other obstructions, because it entangles the wheels and causes the planes to somersault. The provision of this number of landing places made it possible to photograph between 10,000 and 12,000 square miles. The exact area cannot be determined until the photographs are all printed. Two hundred and thirty square miles of vertical photography was completed in the N'Changa area and 12 square miles at Kipushi. This proved of assistance in preparing maps for more thorough prospecting and geological study of the areas photographed, but failed to show up any unknown mineralization. Three thousand square miles of reconnaissance photography was completed, but no ancient workings or new deposits were discovered by this means.

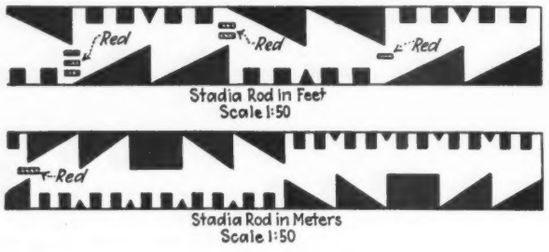
The speed of the work was hampered to an unlooked for extent by bad visibility, due to haze, in the early part of the season, and smoke from grass fires in the latter part of the season. Detailed study of the photographs is still proceeding, and the preparation of plans from them is in the hands of a skilled surveyor. These plans will be of great assistance in the further detailed exploration of the areas photographed. The beauty of these accurate maps emphasizes the difficulty of carrying out rapid and effective exploration of mineral areas without good maps.

USEFUL OPERATING IDEAS

Stadia Rods for Foot and Metric Work

By J. C. Pratt
Cerro de Pasco Copper Corporation, Casapalca, Peru

THE important feature of the stadia rods shown in the accompanying cut is the proportion, design, and arrangement of the large figures, which mark the major divisions and are used in long-distance work. By alternating the designs from side to side for each foot and for each half meter, the rods are easily read, or self-reading. A rod, to be adaptable for both long- and



Sections of stadia rods graduated in feet (above) and in meters (below)

short-distance work, must combine a heavy design that will stand out clearly at great distances with a finer one that may be used for short ranges and that will not interfere with the major divisions on long shots. At the same time, if the rod is to be self-reading the major divisions should be easily discernible at the greatest distance at which the design can be used. These rods combine all of these features and can be used at distances up to the full rod length of three meters, using only half the stadia interval, thus giving 600 meters. The same should apply to the foot rod.

Smaller divisions on either rod may be varied to suit conditions and the use for which the rod is intended. They may be made into finer or coarser divisions, but should not extend laterally farther than those shown, nor should the small black division come close to the major ones.

Use of numbers to mark the feet or meters is purely optional, especially in view of the clearness with which these are marked by the alternating design.

A Flux for Melting Metals

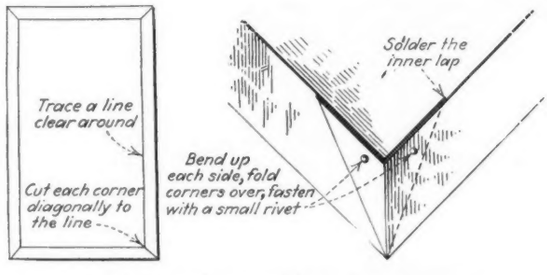
Salt or gypsum may be used as a flux in melting copper and copper alloys, according to a recent issue of *Apparatebau* (abstracted in *Chemical Abstracts,* Vol. 22). A handful of sodium chloride thrown into the crucible after the metal is melted is sufficient for 150 lb. of metal. An excess will damage the crucible, it is stated. Gypsum is also good; it has little effect on the crucible.

Efficiency Increased by Clean Machines

By Charles Labbe
Clarkdale, Ariz.

CLEAN MACHINES, free from oil drips, contribute to the general efficiency of power equipment. Once a machine has been thoroughly cleaned, this condition can be maintained with comparatively little labor Going over each unit daily will often reveal loose parts and small leaks. This inspection repays itself by the prompt discovery of the cause of trouble that might ensue. A few drip pans will diminish the labor of preventing oil and grease spreading upon floors or timbers. These can be readily made out of bright tin or clean galvanized iron. The pieces are cut to size and a line is drawn 1¼ in. from the edges. Each corner is cut and the edges are bent up as shown in the sketch. Corners are folded back and secured by rivets and solder.

New gaskets should be cut and leaky ones replaced. Careful use of lubricating oil and grease will result in greater economy and a reduction in the amount of cleaning required to keep a machine in good condition.


Trace a line clear around
Cut each corner diagonally to the line
Solder the inner lap
Bend up each side, fold corners over, fasten with a small rivet

A drip pan for catching oil and grease

Lubrication of Wire Rope

By R. B. Williams
American Cable Company, Chicago

PRACTICALLY all the cores of good brands of wire rope are thoroughly impregnated with a commercial, chemically neutral rope oil. Though the core retains a liberal supply of this lubricant, which gradually oozes out as the rope is used, frequent application of a good lubricant during service is necessary to prevent the core from becoming dry. A dry core will both wear and crush sooner than an oil-impregnated core. Furthermore, it will absorb moisture, with the result that the core will deteriorate rapidly and the inner wires will corrode, with shortened rope service as the result.

The smaller the sheaves or the heavier the tension on the rope, the more often should the rope be lubricated. A good lubricant retards corrosion of the wires and

deterioration of the core; reduces internal friction, which is the cause of wires breaking from bending stresses, and decreases external wear. Lubricant should be thin enough to penetrate the strands and the core, but not so thin as to run off the rope nor so thick that it merely covers the rope. Therefore, a thicker, semi-plastic compound applied hot and in a thinned condition is the best wherever possible. It will penetrate while hot, then cool to a plastic filler, and exclude the entrance of water. Thus, it both preserves and lubricates the inner wires and cores.

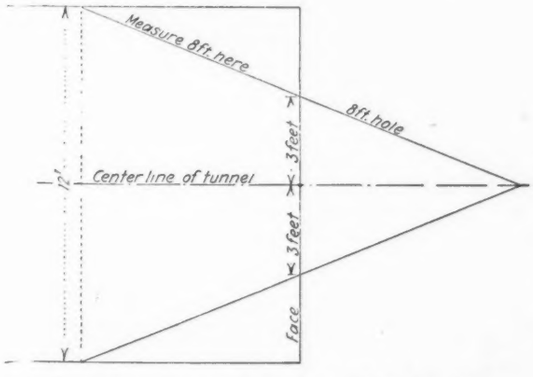
To lubricate properly with a heated lubricant it is necessary to have the rope run slowly through a tank of heated oil. This is the best possible method to allow penetration. Where this is not possible, an application of a thinner and unheated lubricant will give better practical results.

It is always well to lubricate the rope just after installation and before running in service, particularly when such ropes have been kept in storage for any length of time. Acknowledgment is made to the American Cable Company for the data given herein.

Drilling Cut Holes in Tunnels

By Hiram Smith
Wilkes-Barre, Pa.

IN TUNNELING, most cut holes are drilled with the intention of making them meet in the bottom of the hole. Most drillers, however, use their own judgment in aligning the holes and trust to luck that these will not cross before the required depth is reached. Thus they either shorten their cut or drill the holes too straight. To avoid these mistakes it is a good idea to measure the angle of the holes to be drilled, because a well-drilled cut means a saving of powder and time. As most tunnels are driven 8, 10, or 12 ft. wide, I give the measurements for these three widths. For a 12-ft. tunnel, mark the center of the tunnel on the face; also mark a point 3 ft. from the center mark on each side. This shows where the holes are to be drilled. Then measure back along the machine from the collar of the hole the required depth of hole to be drilled, and from this point 12 ft. across the tunnel to the other machine.



Locating the cut holes in a 12-ft. heading

The holes may now be drilled, but care must be taken not to throw the machines out of alignment. For an 8-ft. tunnel, place the holes 2 ft. off center and measure 8 ft. across; for a 10-ft. tunnel, start the holes 2 ft. 4 in. off center and measure 10 ft. across. When only one machine is used, a center point can be taken back about 25 ft. from the face and a line stretched from center to center. A measurement can be taken from this. For other widths of tunnels, a plan can be drawn on paper on a scale of one inch to the foot and measurements taken from this.

To avoid arguments among the mathematically inclined drillers, as there are always a few on the job, let them make the exact calculations by using the method for solving the sides of a right angle, taking the hole as the hypotenuse, the distance the hole started from the center as the altitude, and the depth where the holes cross as the base.

Locating a Leak in an Electric Cable

By G. F. Maughmer
General Electric Company, Phoenix, Ariz.

IN THE early part of September a leak developed in the cable carrying current for the operation of motor-driven pumps in the plant of the Katherine Gold Mining Company, on the banks of the Colorado River in Arizona. Although the equipment was apparently working in perfect order, a darkened ground detector lamp above the main switchboard was the alarm signal which gave warning of impending trouble.

The electrical maintenance men of the mine had worked night and day to locate the leak. It had been determined that it was somewhere between the 400-ft. level and the bottom of the shaft, but the exact location could not be established. Every foot of the cable had been felt over by hand several times, but no hot spot or punctures could be found.

The probability was that the development of a ground anywhere else in the system would disable the cable, in which event the pumps would stop. Before the cable could be repaired the mine would be flooded, expensive machinery would be damaged, operations in the lower levels would be stopped, and a loss of thousands of dollars would result.

A representative of an electrical manufacturing company, called to the spot, made extensive efforts to secure suitable instruments for locating the fault, but neither the near-by power company nor the telegraph company had anything immediately available. Finally a battered Wheatstone bridge and a disabled galvanometer were located in the high school at Kingman, and these were borrowed and rushed to the mine.

After considerable time spent in putting the galvanometer into operating condition, setting it up, leveling and testing, readings were finally taken. This was made difficult by reason of the fact that power could be interrupted only a few minutes at a time.

The calculations indicated that the fault was 44 ft. 4 in. from the lower switch. After a few minutes' search, a small hole was found approximately 45 ft. from the switch, or 8 in. from the point determined by the calculations.

To make conditions dry enough to open and repair the cable on the job it was necessary to build, in the manway, a roof around the cable at the fault. The following morning the work was completed, all the lamps on the ground detector gleamed brightly, and the danger had been averted.

DISCUSSION

Where the Nuggets Are Left

THE EDITOR:

Sir—When, some years ago, the British government's representatives in India sanctioned the invasion of Tibet, ostensibly as retribution for some fancied slight, but, in reality, it was thought, to make free of Lhasa, the "forbidden city," the Tibetans benefited from the punitive expedition. They learned from the conquerors that a land producing gold might advantageously be developed. The Dalai Lama (ruler) did not, however, take kindly to the idea at first. His predecessors, for centuries, had not thought it necessary to dig and delve, and, being a stanch conservative, he saw no reason why the soil should be disturbed. So a decade was allowed to pass without anything more being said about the matter.

Other interests, however, were at stake. The ruler's ministers, hankering after sudden wealth, never lost sight of the fact that their country produced gold, and, greatly daring, from time to time, they egged on the Dalai Lama to take advantage of Nature's gift. Several counselors mysteriously disappeared, since in these Himalayan-bound wilds it is extremely unsafe to dictate to royalty. A pinch of *datura,* the most deadly of all Eastern poisons, placed in the adviser's tea—which, by the way, is flavored with rancid butter instead of sugar—and there was a vacancy in the government service. No questions were asked about the missing ones; but for months thereafter the prime minister and his subordinates adhered to the principles of strict conservatism. It was not considered tactful to expect the "Fount of Wisdom and Understanding," the "Incarnation of Buda," and the "Greatest in the Universe," as the Tibetans entitle their uncivilized potentate, to stray from the paths of hide-bound custom.

Those who had stepped into the shoes of the absentees wisely kept their ideas to themselves.

A BAIT

Lately the Dalai Lama's power has waned somewhat, Tibet no longer being the absolute monarchy that it once was. Consequently, the ministers eventually persuaded the "Fount of Wisdom and Understanding" that a too lavish use of *datura,* in return for sensible advice which was bound to benefit the country, would result in India sending an army to avenge evil deeds, and, incidentally, to work the gold deposits, which are unusually rich. As a result of judicious pressure, arrangements were made to despatch an intelligent young Tibetan to England, in order that he might return to his native land as a duly qualified mining engineer. "The Incarnation of Buda will not repent the innovation," chorused the chief adviser and the minor officials, waxing bold. "The servants of the Greatest in the Universe will fill the royal treasure-chest with more wealth than was ever dreamed of. Affluence awaits Tibet."

A TRIP TO LONDON

The intrepid metallurgist-in-the-making crossed the snow-clad mountain passes, saw a railway train for the first time in his life, and braved the terrors of the Indian Ocean, the Red Sea, and the Mediterranean, to arrive finally in London, where he studied with exemplary diligence, returning to Lhasa with the necessary knowledge. Then came a hitch, and a serious one, too. In the past, the miners had collected only the gold dust, firmly believing that the nuggets were not intended to be removed from their resting place. "Like the birds of the air, they are alive," said the natives. "The nuggets are the parents of the gold dust. Take them from mother-earth, and breeding must naturally cease."

Having wallowed in ignorance from time immemorial, these astonishing people cherish this astounding belief, in which they cannot be shaken. The almond-eyed race, with true Mongolian superstition, also is convinced that gold is the special perquisite of Buda—"than whom there is none more powerful"—and that to remove it must necessarily entail dire calamity. "The Most High has graciously permitted the faithful to use the dust. Being as the crumbs which fall from the richly laden tables of the highly-placed, He has no use for it. But the nugget is another matter; the base slave who dares wrest it from the rightful owner will die an unexpected death."

To come to untimely end is dreaded; it is not considered a decent termination to a life dedicated to upholding the teaching of Buda—"whose unfathomable wisdom passes all human understanding." So when the expert mining engineer, acting under the orders of the government, commenced work, the miners, inspired by the village oracle, promptly went on strike. None would raise a hand.

Fortunately, the powers that be interfered. Armed with the authority of the Dalai Lama himself, and backed up by a regiment of ragamuffin soldiery, they hastily left Lhasa for the gold fields. The senior representative of law and justice harangued his sulky compatriots, informing them that superstition was doomed, that every ounce of gold down to the last point of decimals was intended for the use of the state. "We do not wish to proceed to extreme measures," quoth the orators. "Ours is a benign rule. But just to show you that we are in earnest, an example will now be made of the ring leaders." It was not precisely clear who were the principal malcontents, nor was the head of the mission anxious to fix responsibility.

He simply gave orders to his obedient soldiers to seize half a dozen angry listeners and to peg them to the ground. A favorable position having thus been secured, whips of hardened yak hide were adroitly wielded, and with so excellent a result that weeks passed without any further trouble. Nuggets were added daily to the imperial treasure chest, and the skilled metallurgist anticipated ending his days as prime minister, possibly as Dalai Lama. Rose-colored were his dreams.

North, South, East, and West, gold in large quantities was discovered. Ore abounds everywhere, and the Tibetans, perhaps fearing disciplinary methods, readily took service as miners when called upon to do so. All was well.

MEDDLESOME PRIESTS

Unhappily, at this juncture priestly influence was brought to bear upon the mining operations. Exalted though the ruler of the land is (the "Fount of Wisdom and Understanding," the "Incarnation of Buda" and the "Greatest in the Universe" cannot be otherwise), and powerful though the prime minister and the chief adviser may be, the priests have the final say in matters affecting the unchanging superstitions of the people. Tibet, in fact, is one of the most priest-ridden countries in the world; though pious authority may be flouted for a time, it is bound to reassert itself, and with renewed force. Lousy, ignorant beyond belief, immoral, gluttonous, untruthful and utterly despicable, this scum of humanity has the ear of the populace to a most alarming extent. It is not surprising, therefore, that the priests should have banded themselves together to forbid a continuance of mining enterprise. They exerted their influence from one end of Tibet to the other, declaring that Buda, while permitting gold dust to be removed, needs the ore and nuggets for his own use. "Continue in your impious excavations, and misfortune will fall upon the land! The yaks will die off like flies in winter; plague is certain to decimate the popu-

lation; and, worse still, the religion of our forefathers will be dishonored!"

Thus declared each lama from one end of the country to the other; and two out of every five Tibetans are in the holy business.

MINING FORBIDDEN

Consternation set in. The Dalai Lama, as the "Right Hand of Buda," dared not go against these interfering rascals, while the ministers, fearing a general insurrection, knew better than to stem the tide. Orders were reluctantly issued to the exasperated mining engineer to cease his prospecting, and he, finding discretion the better part of professional zeal, fled the country. Nor did the priests rest content with paralyzing a singularly paying industry. Such is their hold over the superstitious government, that they actually have compelled the "Greatest in the Universe" to make reparation. The "Fount of All Wisdom" has been forced to disgorge all the gold shown on the royal treasury receipts since mining was commenced. The dictators profess to have returned it to—what they term—its proper abiding place. In all probability the treasure is secreted in their malodorous lamaseries.

This happened recently, and unless a convenient scourge carries off the lamas, Tibetan ore and nuggets may remain undisturbed, perhaps, for a century or more. Under the circumstances it is fortunate that the priests, with the sanction of Buda, raise no objection to gold dust being utilized. This is exchanged for silver, traders from China greatly benefiting by the transaction.

GEORGE CECIL.

* * *

Ventilation and Mine Fires

THE EDITOR:

Sir—The mine fire disaster at the Hollinger recently and the lesser one at Magma Copper, in Arizona, in the latter part of 1927, bring into prominence the need for extreme care in the operation of metal mines. Co-operation of underground workers in a general plan of fire prevention is a necessity. In planning the ventilation layout of a mine the probabilities of fire originating at critical places should be carefully studied, as well as the effect of the resultant spread of irrespirable gases. It is highly desirable that the incast side of the ventilation layout should be fireproof, but it is equally necessary to prevent the accumulation of combustible materials; or, if such materials must be stored, to take precautions to prevent their ignition.

The situation in most large mines is much the same—a considerable number of separated places in which groups of men are at work. The safety of these men is dependent upon a continuous supply of good air. Even a small fire in a main incast will rapidly vitiate all the air in the connecting branches. A fire in one of the branch airways or splits will pollute the air in this branch, as well as in the return airway above the point of connection; but the risk is restricted to only a part of the mine. It is for this reason that main incast airways are so critically important and that every effort must be made to provide fireproof construction; or, where this is impossible, to prevent unnecessary accumulation of combustibles and to adopt measures to prevent fire.

Carelessness of workers is to be expected, but it can be overcome by exacting inspection, careful installation of power lines and accessories, and the provision of fire-fighting equipment at critical places.

Fires in metal mines occur at intervals. A study of the circumstances attending the disasters of recent years should serve to awaken mine superintendents to the danger of neglect and the necessity for rigid inspection at frequent intervals. ENGINEER.

San Francisco, Calif.

By the Way

The World's Deepest Well

IT IS reported that the Chanslor-Canfield Midway Oil Company soon expects to drill a well to a depth of nearly two miles—10,000 ft. The company already has a well 8,046 ft. deep, and plans to continue it until it is 10,000 ft. deep. The present well is already the world's deepest.

Authorities state that the venture may not succeed, because tremendous difficulties are encountered at these great depths. Thus, if the drill should twist off, the task of fishing it out would be difficult.

Even if the well is drilled to a depth of two miles, geologists state that it is not likely that the company will ever succeed in making the well produce oil. It apparently is not a business venture but more of a sporting proposition.

At the bottom of the 8,046-ft. well, a temperature of 233 deg. F. has been reached, which is 21 deg. higher than boiling point. With each 50 ft. of depth the temperature increases one degree Fahrenheit. At that rate the temperature at a depth of 10,000 ft. would be about 273 deg. F., or equivalent to a steam pressure of 29 lb. per square inch.

No doubt it would be possible to utilize that heat and make the well dig itself after reaching the temperature high enough to generate steam. But it would be too expensive.

* * *

Streets All Scrambled, Numbers Too, in Butte

A RECENT Associated Press dispatch to the New York *Herald Tribune* will bring a smile to the many mining engineers who are familiar with Butte:

"Butte's streets, zigzagging to miss mine properties, have long been a source of civic annoyance, but to add to the confusion it now has been discovered that sixty-six streets have similar names, and on one street there are five houses with the same number.

"Tradespeople have begun to complain about so many streets with identical names. It is not uncommon for a coal dealer to dispatch two tons of fuel out to Cleveland Street, near Lake Avoka, and find that he should have sent his driver to Cleveland Street near Meaderville. several miles away.

"Butte's streets are a puzzle to the casual visitor. Mine properties jut out like islands in most parts of the city and the streets must go around."

Butte from the air

This photograph lends little support to the charge of zigzagging streets; but the Anaconda Hill section, where the mines are situated, is not shown

"We Tin What We Can"

A PICTURE of hundreds of thousands of American husbands facing famine if anything happens to America's tin supplies was painted recently by Lord Askwith, tin magnate, in a speech before the Royal Colonial Institute of London, according to the New York *World*.

"The United States," he said, "is effectually sealing itself up in a tin can. Half the food Americans eat is tinned. Americans are so busy and so imprisoned in their tinned lives that they never pause to consider what would happen if the tin supply ran out and they had to fall back again on ordinary food.

"It has been estimated that if anything happened to America's tin supplies about 25 per cent of American husbands would go hungry, for the simple reason that tinned food has robbed American women of their culinary art."

Lord Askwith also said that 50 per cent of the world's tin is used in the United States, which, we might add, is an approximately accurate statement.

* * *

Nine Months to Cool

THE BUILDING of a great telescope is an adventure in manufacturing. It is the antithesis of mass production: success results from a coordination of mechanical and optical features, of precise workmanship and good engineering design. The lens is, of course, the important feature, for upon its freedom from flaws, exact grinding and polish depend its usefulness to the astronomer. Recently a disk of glass, about 70 in. diameter and 11 in. thick, was cast by the Bureau of Standards for the Perkins Observatory reflecting telescope, after four unsuccessful attempts had been previously made. The final cast was gradually cooled for nine months. It was uncovered late in January. It is stated that the 3,500-lb. mass is without flaw and the most perfect of the kind known.

The glass was allowed to cool at an average rate of 2½ deg. C., per day, until 460 deg. was reached. It was then annealed at this temperature for six weeks.

* * *

Who Is Who?

"WHO'S WHO IN AMERICA" and "Who's Who in Engineering" are important and useful records. Both are worthy of encouragement. Both should increase in scope and usefulness; but it appears that the idea is breeding. "Who's Who in the Central States," "Who's Who in Dixie," "Who's Who in the West," and other issues of a similarly sectional character are seeking recognition and money. Is it worth while to encourage this expansion? Will not the national publications answer the purpose? The engineer should consider these questions when asked to contribute a payment in advance, and particulars of his history, to such publications.

Consultation

Of Interest to Contributors

"I tried to publish something in a magazine recently, but it was sent back with a printed note stating that unless the manuscript was properly prepared it would not even be read. I see you have a 'Consultation' department. Will you please tell me what the average editor wants. My article was properly typed."

Your manuscript was probably typed single spacing, with the lines close together; and you doubtless neglected to observe some of the other recognized rules in preparing copy. Single-spaced manuscripts are a nuisance to editor, publisher, compositor, and proofreader; and probably for reasons that no one not familiar with editorial routine and publication detail could imagine. Few if any manuscripts are or can be published just as received. They must be edited and copy read to conform to the typographical style adopted by the publication. A main head or caption and cross-column heads must be composed, instructions to printer and proofreader must be written on the copy, including technical detail as to size of type, measure of column, and numerous other instructions respecting composition. Unless the writer of a contribution leaves enough margin space—on all sides—for these data, the manuscript, after being edited and prepared for the printer, must be (1) retyped and checked against the original as corrected; or (2) sent to the compositor as corrected by editor and copy reader. If it be retyped, time is consumed and expense incurred in that process and in the check against the original, as corrected. Often errors are perpetrated in retyping. Delays are created; double handling is inevitable. If the single-spaced article, as edited, be sent direct to compositor, he is compelled to decipher it, as corrected, as best he can. The work of composition is slowed down and complaints develop, in the proofroom as well as in the composing room. Time is lost in all of the operations incident to the handling of the copy. Annoyance is thus inevitable, involving many workers. Mechanization of industry, together with specialization, is responsible for the conditions described. All who voluntarily assume the rôle of authorship will promote their own interests and enhance the chances that their productions will be accepted and printed if they will observe a few very simple rules, for all of which there is sound reason in the technical requirements of publishing. These rules are:

1. Submit all manuscripts in double- or triple-spaced typewritten form.

2. Allow ample space at the top, sides, and bottom of pages. Start the first page of a manuscript at least three inches from the top of the page to allow for the writing of a heading and for printers' instructions.

3. Use standard stationery, 8½ x 11 inches, and black or blue-black typewriter ribbon.

4. Preserve uniformity in capitalization, abbreviations, and in the use of numerals. If writing on a non-technical subject, preferred general practice—as taught in grammar schools, high schools, and colleges—should be followed. If the subject be technical, adopt the typographical and technical forms that are approved by authorities and technicians in the business, trade, profession, or science concerned.

5. Exercise great care in verifying all references and respecting the spelling of names and the accuracy of statistical and other data.

6. Keep in mind the fact that appearances and accuracy are, in a manuscript seen for the first time, half the battle toward careful consideration.

* * *

No Open Market for Vanadium Ore

"Can you give me the approximate cost per pound of vanadium for reducing ores from South America to ferrovanadium in the electric furnace? Is it necessary, to make a marketable product, to refine the alloy further after one passage through the furnace? I observe that you do not quote prices for vanadium ore, although you do quote ferrovanadium. Is there any place where I can obtain authoritative quotations on the ore?"

Costs of reduction are not available from official sources. A figure of 25c. per pound has been mentioned, but the true figure may be higher or lower than this. The Vanadium Corporation of America makes a marketable ferroalloy in a single electric-furnace operation. However, the operation is a delicate one, requiring close metallurgic and electric control; and the furnace and electric regulating devices were specially designed for the particular service. There is no open market for vanadium ores, because the companies that use any considerable quantity have their own sources of supply. During 1926 some imported lead vanadate ores were sold, duty paid, seaboard, at from 55 to 60c. per pound of contained V_2O_5. However in addition to a content of V_2O_5 ranging from 12 to 18 per cent, this ore contained recoverable lead and some copper, which enhanced its value. About this time, also, some sales of Colorado concentrate were reported on the basis of 25c. per pound of V_2O_5, f.o.b. Montrose, Colo.

INDUSTRIAL PROGRESS

Zinc Meta-arsenite—A Timber Preservative

ZINC META-ARSENITE is a new wood preservative that has been developed in the engineering laboratories of the Western Union Telegraph Company, New York. It is described in a paper by L. P. Curtin of those laboratories. It was developed in an effort to find a material which would be as toxic, inexpensive, and permanent as the arsenites of copper, and also have the advantage of being non-corrosive to iron. It is said that these objectives have all been attained with this material.

When a solution containing zinc acetate and meta-arsenious acid is exposed to the air, water and acetic acid evaporate and a precipitate of zinc meta-arsenite is thrown down. The chemical reaction takes place as follows:

$$\underset{\text{(Zinc acetate)}}{Zn(CH_3COO)_2} + \underset{\left(\begin{matrix}\text{Meta-}\\ \text{arsenious}\\ \text{acid}\end{matrix}\right)}{2HAsO_2} \rightleftarrows \underset{\left(\begin{matrix}\text{Zinc meta-}\\ \text{arsenite}\end{matrix}\right)}{Zn(AsO_2)_2} + \underset{\left(\begin{matrix}\text{Acetic}\\ \text{acid}\end{matrix}\right)}{2CH_3COOH}$$

The reaction continues as above shown until all of the zinc is precipitated as meta-arsenite.

Zinc meta-arsenite is of very low solubility in water. Its solubility is not exactly known, but it is of the order of 25 parts per one million parts of water. On the other hand, it is soluble in acid of approximately pH 6. The weakest acid evolved by any of the wood-destroying fungi experimented with is ten times stronger than this. This means that the toxicity toward fungi of the difficultly soluble zinc meta-arsenite is practically as great as though the zinc and arsenious oxides were in solution.

The comparative toxicity of zinc chloride and the new preservative are shown by the following: 0.35 per cent of zinc chloride constitutes the killing point for the fungus *Fomes annosus;* the killing point with zinc meta-arsenite is 0.10 per cent if the preservative is in the powder form and 0.02 per cent if it is in solution. These values, with others, were determined in the Western Union chemical laboratories, according to Mr. Curtin in the paper referred to, from which the foregoing data are taken. The apparent decrease in toxicity where the powder is used is due to the imperfect distribution in the culture of the grains of powder and mechanical inclosure of preservative inside the grains. With a perfect distribution of preservative crystals, such as has been found in wood treated with arsenites of copper and zinc, a difference between the toxicities of the solution and powder diminishes to the vanishing point.

The zinc-arsenic solution has so little effect on iron that it may be regarded as non-corrosive toward that metal. No corrosive effects were observed from contact of the solution with the iron-treating cylinder and other steel and iron equipment. Qualitative tests with iron nails and other small pieces of iron and steel showed no corrosion and only a slight darkening of the brightly polished surfaces.

Wood treated with zinc and copper arsenites shows, after seasoning, an effective distribution of preservative. Microtome sections of yellow pine containing copper arsenite were stained with dilute potassium ferrocyanide and examined at 1,500 diameters magnification. Untreated zones show no color with the reagent, whereas those parts containing copper were colored pink to mahogany. Photomicrographs showed heavy deposits of preservatives in the medullary rays and resin ducts where fungous attack is most severe, and lighter uniform deposits in the cells and cell walls. Microscopic studies on wood treated with zinc meta-arsenite indicate a distribution similar to that observed in wood treated with copper arsenite.

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Half-Yard Shovel Improved

The Harnischfeger Corporation, Milwaukee, has brought out two additional attachments for its recently introduced ½-yd. shovel, the so-called "Groundhog." In this machine, the new hoe and skimmer booms are built of heavy I-beams, securely trussed and braced, all joints being electrically welded. The hoe has a rated digging depth of 16 ft. and the hoe dipper is shaped from boiler plate, the seams being electrically welded. The skimmer bucket is also constructed from boiler plate and has heavy spring bumpers, cast integral with the boom foot, a feature through which heavy jolts on the boom are said to be eliminated.

New Zinc Extraction Process Patented

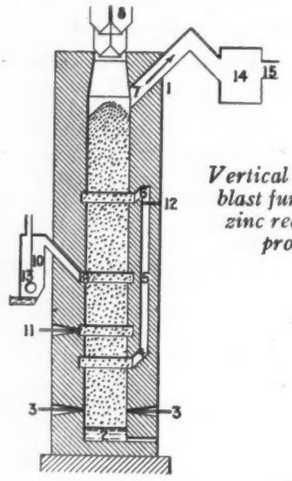
A PROCESS and apparatus for extracting zinc from zinc-bearing material have been devised and patented (U. S. Patent No. 1,652,184, Dec. 13, 1927) by John Skogmark, of New York, who has assigned a half interest in the invention to March F. Chase. The zinc is recovered either as liquid metal or as zinc powder. A high yield of zinc is obtained by this process, the inventor says, and, at the same time, the difficulties heretofore experienced in attempting to extract zinc from ores in furnaces of the general type described are overcome.

The principal methods now in commercial use for extracting zinc are: (1) electrolytic deposition, (2) electrothermic smelting, and (3) retort distillation, Mr. Skogmark states in his application. Except where cheap electric power is available, the last-named process is the one generally used. The disadvantages of this process are that it is a batch process, as distinguished from a continuous one; that it involves the use of small sized units; and that the labor costs are high. It has heretofore been proposed to overcome these disadvantages by continuously producing gases containing zinc vapor in a furnace of the blast-furnace type, into which are charged suitable quantities of zinc-bearing materials, fuels and fluxes, the inventor says. But, so far as he is aware, no attempts of this character have been successful, because, when cold materials are charged into a furnace of this type, carbon dioxide is formed in the gas stream in sufficient quantity to react upon the zinc vapor and contaminate it with an excess of zinc oxide. The result is that the zinc powder (which is the form in which most of the zinc is removed from the gas stream) is coated with oxide to such an extent that it cannot be properly worked in the furnaces that are now generally used for reducing metallic zinc powder to liquid metal. By his process and apparatus, the inventor says, he avoids this difficulty and produces a zinc powder of a character that can readily be reduced to liquid zinc.

The accompanying drawing, which illustrates more or less diagrammatically one embodiment of the invention, is a vertical section of a form of blast furnace which the inventor may employ. This furnace, which is marked "1" in the illustration, has a hearth (2), where heavy reduced metals and the slag resulting from the operations may collect. The usual tuyères (3) are pro-

vided for applying the blast containing oxygen. Either atmospheric air or some other mixture of gases may be used for this purpose. The bypass (5), of which there may be a number, is adapted to bypass part or all of the gaseous products of combustion, taking them off at (4) and returning them to the furnace shaft at (6). Valves (12) are provided for regulating the amount of gases bypassed in this way.

At the top of the furnace the gases pass out at (7) through the fume



Vertical section of blast furnace for zinc reduction process

catcher (14), where any solid matter carried by the gas is collected, and thence through an outlet (15) to be utilized in any desired way.

Provision is made (at 9) for the exit of the zinc-bearing gases, from which the zinc is removed in a condenser (10.)

The manner in which the improved process is carried out in this apparatus is described by the inventor as follows:

After starting the furnace it is charged through the charging doors (8) with a mixture of zinc-bearing ore, a proper reducing agent in the form of carbonaceous fuel, and a suitable amount of material capable of forming a liquid slag with the gangue of the ore and the ash of the fuel. A blast is provided at the tuyères (3). The zinc in the ore is present principally in the form of zinc oxide. The oxygen of the blast combines with the carbon of the charge to form carbon monoxide a short distance above the tuyères, at a temperature of, say, 1,400 to 1,500 deg. C.

At point (4) a large part of these hot gases are bypassed through (5), the remainder passing up through the furnace. The bypassed part of the gases are reintroduced to the charge column at (6). At this point the gases still contain sufficient heat to cause the reduction of substantially all of the easily reducible oxides present in the charge above the point (6). The result is that the charge descending beyond this point contains a mixture of carbon, metallic iron, lead, slag-forming material, some zinc and some zinc oxide, all at a temperature between 900 and 1,050 deg. C. This charge now encounters the part of the hot gases not bypassed at (4). These gases contain sufficient heat to complete the reduction of the zinc oxide, and vaporize the zinc, producing zinc vapor. Gases passing up the shaft from (4) to (6), being reduced in volume and in constant contact with the incandescent carbon in the charge during a comparatively long period, are completely converted to carbon monoxide. Thus, an atmosphere favorable to the existence of metallic vapor is maintained at this zone, and the formation of detrimental quantities of carbon dioxide is avoided. The gases in this zone contain a much larger percentage of zinc vapor than they would if the bypass (5) were omitted.

At (9) those gases, or a part of them, are withdrawn to the condenser (10), where the zinc is condensed as of liquid zinc or zinc powder. Ordinarily it will be condensed as powder, which is taken away by a screw conveyor (13). This powder may then be treated in a well-known manner to obtain liquid zinc.

Between (4) and (9) at times, the inventor says, it may be advantageous to introduce a small quantity of highly heated air or gas containing a higher percentage of oxygen than ordinary air, in order to supply, through the combustion of part of the carbon in this portion, sufficient heat to the charge to volatilize completely the zinc in the charge. For this purpose the tuyères (11) are provided.

Evidently the quantity of gas withdrawn at (9) may be less than the gas current ascending the shaft at (4), in which event there still will be an ascending current from (9) to (6). Under certain conditions, however, it may be found advantageous to withdraw a larger amount of gas at (9) than is ascending the shaft at this point, and if this be done there will be a descending current from point (6) to point (9). These different operating conditions may be conveniently regulated by the amount of gas liberated through (15).

The progress of the charge may be described as follows: First, above point (6), drying and preheating of the charge and reduction or iron, lead, and other content. Second, from point (6) to point (4), reduction and vaporization of ZnO and withdrawal of gas mixture at point (9). Third, from point (4) to point (3), zone of combustion of all carbon and final fusion of the slag. Fourth, below tuyères, collection of slag and non-volatile metals.

The process above described, the inventor asserts, eliminates the disadvantages incident to retort distillation and overcomes the difficulties heretofore experienced in attempting to extract zinc in furnaces of the blast-furnace type. It gives a high yield, eliminating, as it does, substantially all zinc from the residue or slag, and it is economical in operation.

Hydrogen Arc Welding —The Apparatus

WITH the atomic hydrogen method of arc welding, an alternating current is maintained between adjustable tungsten wire electrodes, and hydrogen gas is fed to the arc around the electrodes. The hydrogen molecules are broken up into atoms by the intense heat and, in recombining outside of the arc and in contact with the work, heat is liberated far in excess of that obtainable by any gas flame alone. This heat is used to fuse the metals to be joined, and, where additional metal is required, a filler rod may be fused into the work. The electrode holder used is shown in the cut.

The hydrogen prevents the formation of oxides and hence produces a uniformly strong, ductile, smooth weld. The arc, constantly maintained, but broadly adjustable in size and intensity, lends itself to a wide range of work, according to General Electric.

A complete atomic hydrogen arc welding equipment consists of the following items:

One of two insulating transformers for changing the voltage of the supply circuit to that required for the welding circuit.

A variable reactor which automatically controls the current to start the arc and maintains the desired welding current.

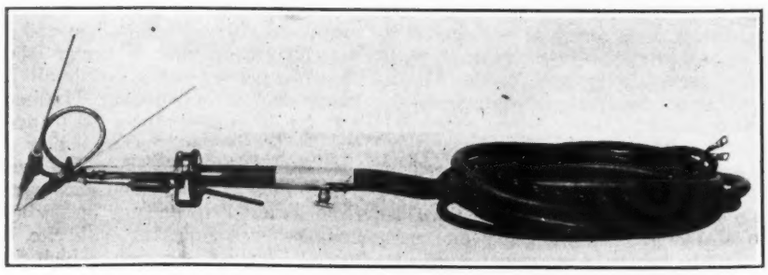
A control panel mounting the reactor, the adjustment for the reactor, an ammeter, a relay, and a contactor.

A "start-and-stop" push-button station with 15 ft. of 3-conductor cable.

An electrode holder equipped with 20 ft. of twin-conductor cable and 20 ft. of gas tubing.

Twelve tungsten wire electrodes, each 12 in. in length. For welding thin materials, using currents not over 30 amp., $\frac{1}{16}$-in. diameter electrodes are used. For currents greater than 30 amp., use $\frac{1}{8}$-in. diameter electrodes.

Users of this equipment will require a supply of hydrogen gas, a gas pressure gage, and a reducing valve by means of which the gas pressure is reduced and regulated.



Equipment used in atomic hydrogen method of arc welding

NEWS OF THE WEEK

Summary

SECRETARY HOOVER denies favoring a large central experiment station at Salt Lake City rather than increased appropriations for existing U. S. Bureau of Mines stations. Representative Winter presents a bill in Congress which would grant an appeal from decisions of Secretary of the Interior in war mineral claims.

* * *

Excessive costs of handling metal at Tampico, it is alleged, will lead to the use of the ports of Galveston and Corpus Christi, Tex., in preference.

* * *

Leslie Urquhart makes known the plans of the Russo-Asiatic Consolidated in connection with its Mount Isa properties. If co-operation from Queensland government is obtained, everything should be in full swing in 1930.

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Transportation is the biggest problem of the Alaskan mining industry. Plans are being made for road construction and bus service during the coming summer.

* * *

Basin district, in Jefferson County, Mont., is reporting some activity. Jib Consolidated properties may be reorganized. Montana-Idaho has completed its plant at Spring Hill, near Helena.

* * *

Teck-Hughes, Kirkland Lake Gold, and Lake Shore developments have disclosed additional tonnages recently at their mines in the Kirkland Lake district.

* * *

Russian authorities are beginning to realize that their country's resources cannot be developed without capital. Investors in Russian mines are consequently more hopeful.

* * *

Production of silver at the Keeley mine, in South Lorrain, has decreased to 50,000 oz. a month. Dividend payments have been cut in half. Officials are actively in search for new properties.

Fire Raging at Aurora Mine

Eleven Known Dead and Several Missing at Teziutlan Unit of Mexican Corporation—Not Yet Under Control

KNOWN DEAD in the fire at the Aurora mine of the Mexican Corporation, near Teziutlan, State of Puebla, Mexico, are 11, with the official number of missing put at 10, although estimates run as high as 50. The fire started on Friday, March 9, and is still burning. It was discovered early in the morning, at a time when there were about 80 men underground. Some of these were rescued, but reports as to how many are exceedingly vague. One of the rescuers was killed by the carbon monoxide gas that has forced the temporary abandonment of all rescue work. A proposal has been made to stop up the air passages of the mine to quench the fire. This is taken to mean that all hope for the men still in the mine has been abandoned.

According to a dispatch from a government inspector of mines, it is said that the situation in the mine makes the fire extremely difficult to handle. Portions of the workings are caving in at frequent intervals, and, with the failure of the pumps to act, water is flooding the lower levels. For a time it was feared that the fire might reach large quantities of explosives which had been stored underground. The resulting explosion would have been sufficient to blow up the entire village of Teziutlan. However, it is stated that the powder house is located in a part of the mine quite distant from the scene of the fire, and that danger of an explosion is therefore slight.

As with most mine fires, the origin of this one is not known. However, it is believed that it may have resulted from the carelessness of the workmen in lighting fires with which to heat their food. The company hopes to extinguish the fire within a few days, but nothing in reports would indicate that this is more than a hope.

The Aurora mine belongs to the Teziutlan Copper Mining & Smelting Company, but has been under lease to the Mexican Corporation, a subsidiary of Santa Gertrudis, Ltd., since 1919. The property is located about 130 miles east of Mexico City. It covers an area of 2,500 acres.

The mill was remodeled about two years ago to treat approximately 200 tons of ore a day. The ore carries copper and zinc, with silver and lead as secondary metals. The mine and mill have been operating at a profit for some time.

Three Men Killed in Fire at Badger Mine

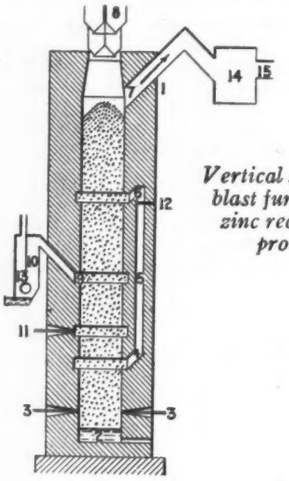
THREE miners employed by Anaconda Copper were overcome by smoke and gas from a fire in the Badger State mine of the Anaconda company, that started after the night shift of the Badger State had left the underground workings at 2:30 a.m. on March 1. It was not discovered until 8 a.m. when the day shift went to work. The dead miners had been trying to prevent fumes from the fire from entering the adjoining Diamond mine, also an Anaconda property. Immediately fire fighters from all the Anaconda properties were summoned in an attempt to block off the blaze by concrete bulkheads and brattices. The men who were killed, James White, Edward Barnes, and William Hasty, were among a number assigned to the opening between the Diamond and Badger State mines. Their objective was accomplished, but not until after death had taken its toll. Failure to prevent the entrance of the fumes into the Diamond workings would have meant the shutting down of both properties. As it is, it is not expected that Badger State will be able to produce again until the beginning of April. Four hundred men are employed at this mine.

Big British Lead Mine Closes

For the first time in its history of seventy years the Mill Close lead mine, near Matlock, England, is stopping production owing to the low price of lead that has been brought about by foreign competition. Mr. Williams, the general manager, states that meanwhile research development work will be carried on. This includes working a vein below water level. The cessation of production seriously affects several local villages, where the mine provided the chief occupation for industrial workers. It is said that this mine has produced one-third of the total output of lead ore in the British Isles.

vided for applying the blast containing oxygen. Either atmospheric air or some other mixture of gases may be used for this purpose. The bypass (5), of which there may be a number, is adapted to bypass part or all of the gaseous products of combustion, taking them off at (4) and returning them to the furnace shaft at (6). Valves (12) are provided for regulating the amount of gases bypassed in this way.

At the top of the furnace the gases pass out at (7) through the fume



Vertical section of blast furnace for zinc reduction process

catcher (14), where any solid matter carried by the gas is collected, and thence through an outlet (15) to be utilized in any desired way.

Provision is made (at 9) for the exit of the zinc-bearing gases, from which the zinc is removed in a condenser (10.)

The manner in which the improved process is carried out in this apparatus is described by the inventor as follows:

After starting the furnace it is charged through the charging doors (8) with a mixture of zinc-bearing ore, a proper reducing agent in the form of carbonaceous fuel, and a suitable amount of material capable of forming a liquid slag with the gangue of the ore and the ash of the fuel. A blast is provided at the tuyères (3). The zinc in the ore is present principally in the form of zinc oxide. The oxygen of the blast combines with the carbon of the charge to form carbon monoxide a short distance above the tuyères, at a temperature of, say, 1,400 to 1,500 deg. C.

At point (4) a large part of these hot gases are bypassed through (5), the remainder passing up through the furnace. The bypassed part of the gases are reintroduced to the charge column at (6). At this point the gases still contain sufficient heat to cause the reduction of substantially all of the easily reducible oxides present in the charge above the point (6). The result is that the charge descending beyond this point contains a mixture of carbon, metallic iron, lead, slag-forming material, some zinc and some zinc oxide, all at a temperature between 900 and 1,050 deg. C. This charge now encounters the part of the hot gases not bypassed at (4). These gases contain sufficient heat to complete the reduction of the zinc oxide, and vaporize the zinc, producing zinc vapor. Gases passing up the shaft from (4) to (6), being reduced in volume and in constant contact with the incandescent carbon in the charge during a comparatively long period, are completely converted to carbon monoxide. Thus, an atmosphere favorable to the existence of metallic vapor is maintained at this zone, and the formation of detrimental quantities of carbon dioxide is avoided. The gases in this zone contain a much larger percentage of zinc vapor than they would if the bypass (5) were omitted.

At (9) those gases, or a part of them, are withdrawn to the condenser (10), where the zinc is condensed as of liquid zinc or zinc powder. Ordinarily it will be condensed as powder, which is taken away by a screw conveyor (13). This powder may then be treated in a well-known manner to obtain liquid zinc.

Between (4) and (9) at times, the inventor says, it may be advantageous to introduce a small quantity of highly heated air or gas containing a higher percentage of oxygen than ordinary air, in order to supply, through the combustion of part of the carbon in this portion, sufficient heat to the charge to volatilize completely the zinc in the charge. For this purpose the tuyères (11) are provided.

Evidently the quantity of gas withdrawn at (9) may be less than the gas current ascending the shaft at (4), in which event there still will be an ascending current from (9) to (6). Under certain conditions, however, it may be found advantageous to withdraw a larger amount of gas at (9) than is ascending the shaft at this point, and if this be done there will be a descending current from point (6) to point (9). These different operating conditions may be conveniently regulated by the amount of gas liberated through (15).

The progress of the charge may be described as follows: First, above point (6), drying and preheating of the charge and reduction or iron, lead, and other content. Second, from point (6) to point (4), reduction and vaporization of ZnO and withdrawal of gas mixture at point (9). Third, from point (4) to point (3), zone of combustion of all carbon and final fusion of the slag. Fourth, below tuyères, collection of slag and non-volatile metals.

The process above described, the inventor asserts, eliminates the disadvantages incident to retort distillation and overcomes the difficulties heretofore experienced in attempting to extract zinc in furnaces of the blast-furnace type. It gives a high yield, eliminating, as it does, substantially all zinc from the residue or slag, and it is economical in operation.

Hydrogen Arc Welding —The Apparatus

WITH the atomic hydrogen method of arc welding, an alternating current is maintained between adjustable tungsten wire electrodes, and hydrogen gas is fed to the arc around the electrodes. The hydrogen molecules are broken up into atoms by the intense heat and, in recombining outside of the arc and in contact with the work, heat is liberated far in excess of that obtainable by any gas flame alone. This heat is used to fuse the metals to be joined, and, where additional metal is required, a filler rod may be fused into the work. The electrode holder used is shown in the cut.

The hydrogen prevents the formation of oxides and hence produces a uniformly strong, ductile, smooth weld. The arc, constantly maintained, but broadly adjustable in size and intensity, lends itself to a wide range of work, according to General Electric.

A complete atomic hydrogen arc welding equipment consists of the following items:

One of two insulating transformers for changing the voltage of the supply circuit to that required for the welding circuit.

A variable reactor which automatically controls the current to start the arc and maintains the desired welding current.

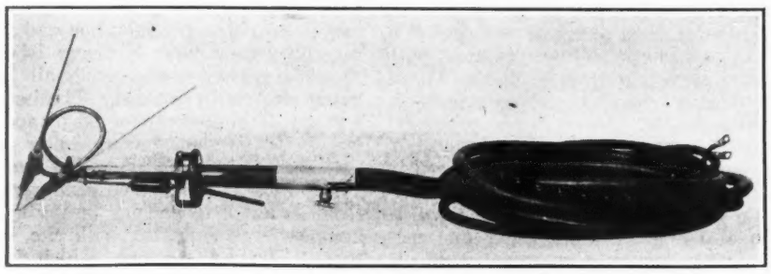
A control panel mounting the reactor, the adjustment for the reactor, an ammeter, a relay, and a contactor.

A "start-and-stop" push-button station with 15 ft. of 3-conductor cable.

An electrode holder equipped with 20 ft. of twin-conductor cable and 20 ft. of gas tubing.

Twelve tungsten wire electrodes, each 12 in. in length. For welding thin materials, using currents not over 30 amp., $\frac{1}{16}$-in. diameter electrodes are used. For currents greater than 30 amp., use $\frac{1}{8}$-in. diameter electrodes.

Users of this equipment will require a supply of hydrogen gas, a gas pressure gage, and a reducing valve by means of which the gas pressure is reduced and regulated.



Equipment used in atomic hydrogen method of arc welding

NEWS OF THE WEEK

Summary

SECRETARY HOOVER denies favoring a large central experiment station at Salt Lake City rather than increased appropriations for existing U. S. Bureau of Mines stations. Representative Winter presents a bill in Congress which would grant an appeal from decisions of Secretary of the Interior in war mineral claims.

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Excessive costs of handling metal at Tampico, it is alleged, will lead to the use of the ports of Galveston and Corpus Christi, Tex., in preference.

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Leslie Urquhart makes known the plans of the Russo-Asiatic Consolidated in connection with its Mount Isa properties. If co-operation from Queensland government is obtained. everything should be in full swing in 1930.

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Transportation is the biggest problem of the Alaskan mining industry. Plans are being made for road construction and bus service during the coming summer.

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Basin district, in Jefferson County, Mont., is reporting some activity. Jib Consolidated properties may be reorganized. Montana-Idaho has completed its plant at Spring Hill, near Helena.

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Teck-Hughes, Kirkland Lake Gold, and Lake Shore developments have disclosed additional tonnages recently at their mines in the Kirkland Lake district.

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Russian authorities are beginning to realize that their country's resources cannot be developed without capital. Investors in Russian mines are consequently more hopeful.

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Production of silver at the Keeley mine, in South Lorrain, has decreased to 50,000 oz. a month. Dividend payments have been cut in half. Officials are actively in search for new properties.

Fire Raging at Aurora Mine

Eleven Known Dead and Several Missing at Teziutlan Unit of Mexican Corporation—Not Yet Under Control

KNOWN DEAD in the fire at the Aurora mine of the Mexican Corporation, near Teziutlan, State of Puebla, Mexico, are 11, with the official number of missing put at 10, although estimates run as high as 50. The fire started on Friday, March 9, and is still burning. It was discovered early in the morning, at a time when there were about 80 men underground. Some of these were rescued, but reports as to how many are exceedingly vague. One of the rescuers was killed by the carbon monoxide gas that has forced the temporary abandonment of all rescue work. A proposal has been made to stop up the air passages of the mine to quench the fire. This is taken to mean that all hope for the men still in the mine has been abandoned.

According to a dispatch from a government inspector of mines, it is said that the situation in the mine makes the fire extremely difficult to handle. Portions of the workings are caving in at frequent intervals, and, with the failure of the pumps to act, water is flooding the lower levels. For a time it was feared that the fire might reach large quantities of explosives which had been stored underground. The resulting explosion would have been sufficient to blow up the entire village of Teziutlan. However, it is stated that the powder house is located in a part of the mine quite distant from the scene of the fire, and that danger of an explosion is therefore slight.

As with most mine fires, the origin of this one is not known. However, it is believed that it may have resulted from the carelessness of the workmen in lighting fires with which to heat their food. The company hopes to extinguish the fire within a few days, but nothing in reports would indicate that this is more than a hope.

The Aurora mine belongs to the Teziutlan Copper Mining & Smelting Company, but has been under lease to the Mexican Corporation, a subsidiary of Santa Gertrudis, Ltd., since 1919. The property is located about 130 miles east of Mexico City. It covers an area of 2,500 acres.

The mill was remodeled about two years ago to treat approximately 200 tons of ore a day. The ore carries copper and zinc, with silver and lead as secondary metals. The mine and mill have been operating at a profit for some time.

Three Men Killed in Fire at Badger Mine

THREE miners employed by Anaconda Copper were overcome by smoke and gas from a fire in the Badger State mine of the Anaconda company, that started after the night shift of the Badger State had left the underground workings at 2:30 a.m. on March 1. It was not discovered until 8 a.m. when the day shift went to work. The dead miners had been trying to prevent fumes from the fire from entering the adjoining Diamond mine, also an Anaconda property. Immediately fire fighters from all the Anaconda properties were summoned in an attempt to block off the blaze by concrete bulkheads and brattices. The men who were killed, James White, Edward Barnes, and William Hasty, were among a number assigned to the opening between the Diamond and Badger State mines. Their objective was accomplished, but not until after death had taken its toll. Failure to prevent the entrance of the fumes into the Diamond workings would have meant the shutting down of both properties. As it is, it is not expected that Badger State will be able to produce again until the beginning of April. Four hundred men are employed at this mine.

Big British Lead Mine Closes

For the first time in its history of seventy years the Mill Close lead mine, near Matlock, England, is stopping production owing to the low price of lead that has been brought about by foreign competition. Mr. Williams, the general manager, states that meanwhile research development work will be carried on. This includes working a vein below water level. The cessation of production seriously affects several local villages, where the mine provided the chief occupation for industrial workers. It is said that this mine has produced one-third of the total output of lead ore in the British Isles.

Hoover Denies Favoring Central Station Rather Than Increased Appropriations For Existing Bureau Stations

By Paul Wooton
Special Washington Correspondent

A REPORT circulated last week to the effect that Secretary Hoover favors a large central experiment station at Salt Lake City ahead of increased appropriations for existing Bureau of Mines stations has been denied vigorously by him. The report called forth a protest from Senator Oddie, who declared that any such position "would be a hard blow to the mining industry in general and a repudiation of work done at the request of the mining industry." Continuing, he said, "I am for both the central station and for increased aid for local stations, but not for one to the exclusion of the other." In reply Secretary Hoover said: "I quote your last sentence, 'I am for the central station and increased aid for the local stations, but not for one to the exclusion of the other.' That is exactly what I have said on the subject, and no one has any right to quote me in any other direction."

In this connection it was pointed out that because of the political situation there are persons who without hesitation will misrepresent Mr. Hoover's attitude.

Printed copies of the hearing dealing with the need of increased co-operation by the federal government with the mining industry now are available for distribution. This document is regarded as a particularly valuable addition to current mining literature. This correspondent, if addressed at the National Press Building, Washington, D. C., will be glad to forward copies to those applying. It is hoped that more than the supply allowed the committee may be made available by printing the hearings as a Senate document as well.

War Minerals Relief Again

Arguments on the bill which would grant an appeal from decisions of the Secretary of the Interior in claims of losses involved in war-time production of chrome, manganese, tungsten, and other minerals were heard by the House Committee on Mines and Mining on March 7. Representative Winter, of Wyoming, the author of the bill, expressed his belief that it is an improvement over a measure on the same subject that he had introduced at the last session of Congress and which failed to come to a vote.

Mr. Winter explained that the production of these minerals during the war had been carried forward on an emergency basis with the understanding that a law would be passed making reimbursements for losses occasioned. "The law was passed," he said, "but the Secretary of the Interior, who was instructed to make adjustments, has repeatedly refused to include in 'net losses,' items of interest on borrowed capital and the purchase price or rent for the leasing of property."

Testimony was given by former Representative James A. Good, who appeared as the representative of Edward Marshall, of Philadelphia, and other war-mineral claimants. Stating that his client had lost $1,000,000 in the production of manganese, Mr. Good proceeded to submit evidence of other cases involving great losses. He charged that the Secretary of the Interior had not handled these cases properly and that therefore appeal should be allowed to the Court of Claims, as provided for in Mr. Winter's bill.

"Persons who mined and manufactured these materials," Mr. Good declared, "were told that, after the war, importations of such minerals would not be allowed and they would thus be protected. Instead of an embargo being placed on these products, however," he continued, "these metals were allowed to flood the country a short time after the war was over, and many American firms were forced into bankruptcy."

Representative Robsion, of Kentucky, pointed out that there are more than 1,200 cases involved, 396 of which are concerned with loss of interest and the cost of property. To an objection of Representative Arentz, of Nevada, who stated that the bill would open up a whole field of claims, Mr. Winter replied that there ought not to be discrimination against any claimant.

The committee is expected to recommend the passage of the Winter bill.

Radioactive Ore Accidentally Discovered in Africa

A DEPOSIT of uranium was recently found on a farm near Gordonia, in the Upington district of the Cape Colony, Africa. A. Marsh, owner of the farm, says that the discovery was accidental, to a large extent. Over two years ago Mr. Marsh sunk a well on his farm to get water for stock. One day a rather heavy stone, coated with yellow, was found after dynamite had been used in making roads to the well. It was said to be about the size of a pigeon's egg; but it weighed 4 lb. Inspection proved it to be pitch black inside. Mr. Marsh kept it for some time as a curiosity, but later gave it away. It fell into the hands of a person who recognized it as radioactive, and who subsequently visited the farm. Altogether about 100 lb. of pure pitchblende was found on that particular spot, and inspection disclosed another deposit about two miles to the east.

Improved Transportation Is Vital to Alaska Mining Development

TRANSPORTATION is the biggest problem confronting the mining industry in Alaska. A service by six $10,000 auto coaches is now proposed between Valdez and Circle City on the Yukon River. This would give the placer miners in the Fairbanks and Circle City regions direct communication with the coast. The Alaska road commission has arranged for the construction of a good road to provide transportation to the Casadepaga River on the Seward peninsula from the coast. Hitherto this part of the peninsula has been inaccessible. Construction of this road will probably lead to investigation of the possibilities of the Casadepaga River as dredging ground.

At Hyder, Mountainview Gold is driving a new tunnel to prove at depth promising oreshoots in the Marsh and Gold veins. Development on the 500 level of the Hirst-Chicagoff mine has proved the extension to that depth of the rich oreshoot encountered in upper workings. The vein is reported to be 4 ft. wide at this level. Elmes Gold Mining, in the Fairbanks district, is adding another unit of five stamps to the battery at its mill. Sufficient ore has been blocked out during the winter to run the mill throughout the coming winter. Fern Gold Mining also plans addition to its milling plant at Willow Creek. It is possible that the mill will be run throughout the year hereafter.

According to the Inspector of Mines for Alaska, the number of fatal accidents in mines in the territory during 1927 were ten. This is two more than occurred in 1926. However, a larger number of men was employed and the proportion between fatalities and workers remained the same. Of the fatalities, six occurred in quartz mines; two in placer mining; one in a marble quarry; and one in a coal mine.

Developments at Cortez Silver Disclose New Orebody

REPORTS FROM the Cortez mine, at Cortez, Nev., operated by the Consolidated Cortez Silver Mines, indicate that present mine conditions are the best in its history. Recent developments in the mine, from the lower or Arctic tunnel, which is below most of the old workings, have disclosed a large tonnage of good-grade mill ore. This ore has been proven to extend 160 ft. above the tunnel, and 110 ft. below it, with limits undetermined.

The new ore is hard and sulphide in character, and the recent changes in mill design, from cyanide to flotation, have resulted in the treatment of a larger tonnage and better extraction. James O. Greenan is superintendent, and the recent improvements are credited to his efforts.

Production at Keeley Silver Is Declining

Output of South Lorrain Mine Now About 50,000 Oz. Monthly—Dividend Is Lowered

KEELEY SILVER, one of the Huronian Belt subsidiaries, produced only 159,000 oz. of silver for the three months ended Jan. 31. Two years ago, in the first part of 1926, Keeley was producing 125,000 oz. a month. It is evident that the ore reserves of the company are being depleted rapidly, and production will probably be held to about 50,000 oz. a month in the future. The directors of the company recently cut the dividend from 8 to 4 per cent half yearly, but even at this rate dividends account for more than half the company's earnings at present.

R. S. Dening, appointed managing director of the Huronian Belt and affiliated companies to succeed Dr. J. Mackintosh Bell, returned recently from a visit to the directors in England. He announces that Keeley will join with the Huronian Belt and the Pioneer Mining Corporation in an exploration program in search of new properties, each company taking one-third. These companies have already taken options on eighteen claims north of the Sherritt-Gordon property in the The Pas district of Manitoba. Exploration is also being undertaken in the Sudbury district of Ontario, under the direction of Dr. H. C. Boydell, who has been appointed consulting engineer.

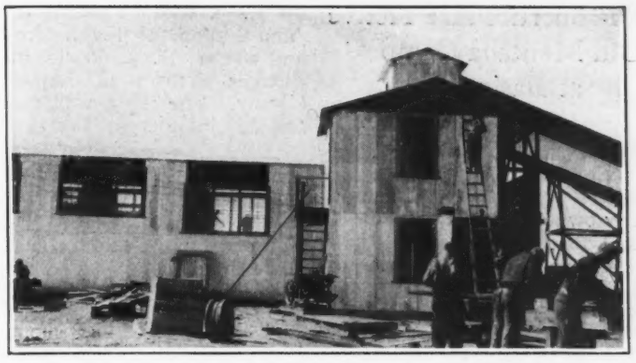
Urge Tungsten Duty Increase

Applications for an increase of 50 per cent in the tungsten duty have been made by three domestic producers. The present duty is 45c. per pound on the actual tungsten content. This rate of duty represents 200 per cent of the foreign value of the imports.

There has been a considerable decrease in the price of tungsten concentrates and it is understood that present operations are not remunerative.

Suction Dredge to Be Used on Arkansas River

INTERNATIONAL Hydraulic Dredging, of Colorado Springs, has completed a new all-steel dredge to operate by means of a suction process. It is 18x38 ft., with a draft of 4½ ft., and cost approximately $70,000. It is to be used on the Arkansas River between Malta and Buena Vista. Means, which it is thought will be adequate, have been provided for removing the boulders encountered in dredging. The presence of these boulders had made older methods impractical. The International company owns patents for the process.



New concentrator of Peru Mining at Deming, N. M.

New Mexico Properties Show Activity

Peru Mining Completes 100-Ton Plant —Waldo Properties Plan Electrification

PERU MINING, a subsidiary of Illinois Zinc, has just completed a 100-ton concentrator at Deming, N. M. Its mine properties in New Mexico are located near Hanover. It also owns mines near Baxter Springs, Kan. The principal building of the new plant is 28x68 ft. The crushing and filtering equipment is housed in two separate structures, one 20x40 ft. and the second 20x20 ft. This concentrator is the first unit of a much larger plant under consideration.

According to Robert Gray, general manager of Southern Metals Corporation, located near Lordsburg, N. M., a contract has been signed for the electrification of all power at the Waldo properties of the corporation. Texas-Louisiana Power will build a high-tension power line for this purpose.

A gold strike is reported in the foothills of the Mogollon Mountains, 4 miles east of Glenwood, N. M., and about 60 miles from Silver City. It is said to be a vein of quartz, about 30 ft. wide, with a showing of free gold.

Black Hawk Consolidated Mines, located at Santa Rita, in the Silver City district, is considering the construction of a 100-ton concentrating plant. Black Hawk ore carries silver, lead, copper, and zinc.

World's Richest Diamond Field Discovered

AN ITEM "for district mining development, £2,500," in the estimates of additional expenditure, led, during a debate in the South African Union House of Assembly, to the revelation of a romantic story of the discovery of a fabulously rich alluvial deposit of diamonds at Alexandra Bay, near the mouth of the Orange River. This might have passed unnoticed but for a casual inquiry by Sir Drummond Chaplin to the Minister of Mines, Mr. Beyers, who then revealed that the item stood for the establishment of state diamond diggings at Alexandra Bay, where Dr. Merensky recently discovered a rich pocket.

The government plans to employ 60 Namaqualand residents as diggers to work the field on behalf of the state, the profits to be applied to the capital expenditure of the Union. In order not to depress the diamond market, the government will control sale and output.

Sir David Harris, who is a director of De Beers Consolidated Mines, Ltd., said that Alexandra Bay constituted the richest diamond field ever discovered in any country. The state owns 100 claims, whence experts extracted diamonds to the value of £160,000 in a few weeks by hand picking. Mr. Beyers stated that any one walking over the claims could pick up stones. Offers of millions of pounds were made to the government for rights last December.

Silica Plant Opened in San Diego County, Calif.

A SILICA plant was opened in February by the Crystal Silica Sand Company near Oceanside, San Diego County, Calif. Capitalized at $100,000, this company, financed and operated by Los Angeles interests, has already installed $75,000 worth of machinery. The supply of silica sand is on the 80 acres owned by the company and is above the railroad level, permitting mining, screening, washing, processing, drying, and loading by gravity. The company will produce a high grade of stucco sand carrying an unusually high silica content and free from clays. The raw sand contains 92.34 per cent silica. Byproducts turned out will include sharp, clean silica sand running from 90 to 98 per cent silica content, screened to size and standards required in the glass industry. Blast sand will also be produced, screened to all standards, as well as a fine smooth pigment binder for paint manufacturers, a chemically pure and sized standard for face brick and pottery, glazine, and ceramic production. The plant has a daily capacity of between 100 and 350 tons.

Completed construction includes three bins for sack loading and six bins for bulk loading, with a total bin capacity of 700 tons. The large drier installed has a maximum feed of 35 tons an hour.

Several Properties Are Active in Old Montana Camp at Basin

THE old camp of Basin, Jefferson County, Mont., is reporting some activity, advices stating that steps are being taken to reorganize the properties formerly owned by Jib Consolidated Mining, and that Crystal Copper has encountered some copper-silver ore of better than average grade at its Cataract Creek properties. Doris Mining is the newest active producer. This company has taken over the properties of Doris Leasing on Basin Creek, about 1¼ miles from the town of Basin. A tunnel, 152 ft. long, has been driven, and a shaft at the end has encountered 10 ft. of ore about 15 ft. below the tunnel level. At present it is intended to continue the shaft sinking another 75 ft. The ore contains good values in zinc, lead, silver, and gold.

Jib Consolidated was formed in 1923 to take over the Hope and Katie mines, in the Basin district. For a time it was regarded as being the premier gold producer of Montana, but it suddenly collapsed at the end of 1924. A good deal of interest is attached to the reopening of its properties, Katie Extension in particular being regarded as a very promising mine.

Montana-Idaho Mines has completed its new fine-grinding cyanide plant, designed to treat 175 tons a day, at the Spring Hill mine, near Helena. The ore is delivered from the mine to a Blake crusher and thence to a Symons cone crusher. The mill is several hundred yards from the crushing plant, as it was necessary in building the mill to make special provisions for tailings disposal. In fact, delay in constructing a plant at this site had been caused by the fact that it is located on a stream that furnishes part of the domestic water supply for Helena, and permission could not be obtained to place tailings near this stream. Finally it was arranged to construct the plant on a creek west of the main stream and to stack the tailings dry, thus assuring that neither cyanide nor pulp would be in danger of polluting the stream.

Crushed ore is carried to the mill on a long conveyor. Flow is entirely by gravity, except from the Dorr classifier to the first thickener, for which a Wilfley sand pump is used. Dorr mechanical and air-lift agitators are used, because the ore, when crushed through 80 mesh, does not make natural slime, but is granular and not easily kept in suspension. A special contrivance is used to keep the pulp from settling in the tank of the Oliver continuous drum filter. Tonnage in sight at the Spring Hill mine amounts to about 250,000 tons of $6 gold.

Ardsley Butte is going to sink a new shaft on the Amarzon claim, west of the Highland shaft, and has already started to sink the Highland workings from the 350 to 500 level. It is shipping 100 tons of silver ore a day.

Nakoma Mines has been organized by R. J. Dee, Thomas Cooney, and John Fulton, of Helena, to take over and operate the Golconda mine, in the Stemple district of Lewis & Clark County. The mine, which carries gold ore, adjoins the Jay Gould mine.

Alice in Wonderland Visits a Tri-State Mine

ON THE AFTERNOON of March 6, Miss Lucille Thomas, aged 22 months, of Picher, Okla., set forth on a tour of inspection of the properties of the newly formed Evans-Wallower Lead Company. Perceiving a mysterious though none the less inviting aperture near the shaft of the No. 2 mine, Miss Thomas proceeded to investigate with the curiosity natural to her sex. She successfully overcame whatever difficulties a barbed wire fence may offer to a person of her age, education, and proportions, and advanced inquisitively on the shaft, which has not been used for a considerable time. In the course of her investigations she unfortunately ventured too far, and, obeying the irresistible impulses of the law of gravity, commenced a rapid descent of 210 ft. to the bottom of the shaft. Remembering well the experiences of her illustrious predecessor, Alice, she took great care not to come into bodily contact with the walls of the shaft. At the end of her interesting though somewhat hurried trip she encountered a cushion of mud, 2 ft. thick, which her guardian angel had doubtless provided for just such an emergency.

Her absence, in the meanwhile, had been noticed by an anxious world, and when finally extricated from her miry resting place she was in a physically sound, albeit lachrymose, state. Doctors, after an examination, reported that the only possible harmful effect on her health as a result of the adventure would be due to her stay in the damp and chilly environment that characterizes the bottom of an unused mine shaft. Miss Thomas has as yet made no statement to the press.

Employees Sue Dura Mining

Suit against Dura Mining Company, of Sonora, has been filed in the Federal Arbitration court of Mexico City by discharged employees under the indemnity clause of the labor laws. The amount asked for is 35,000 pesos. Dura has been reducing expenses for some time, and, incidentally, letting out surplus labor.

Metal Shippers Plan to Use Texan Ports Rather Than Tampico

ACCORDING to recently published reports from Monterey, Mexico, large smelting and mining interests of Mexico are planning to divert their shipments of metals from the Mexican port of Tampico to Galveston and Corpus Christi, Tex. For some time shippers have been trying to have the cost of handling metal in Tampico reduced, but their efforts have met with no success. One of the heaviest metal shippers says that Tampico, at present, is the most expensive port in the world for the handling of minerals. In addition, railroad rates to the port are said to be excessive. The matter has been discussed with the president of the Mexican republic and with the national chambers of commerce, as well as with the Maritime Association.

For a number of years metal exports have been an important item in shipments from Tampico. The amount of tonnage handled has increased steadily since 1924. In that year, metal exports were 45,000 tons. The next year saw these more than doubled, total shipments being 135,000. Tonnage for 1926 was 175,000 and for 1928 240,000. Zinc concentrates and zinc calcines have been the principal exports, although copper, lead, and arsenic have also been handled in good quantities.

Robert Driscoll, chairman of the Corpus Christi Navigation Commission, has received information from American Smelting & Refining that it is ready to ship more than 300,000 tons of bullion and ores annually through Corpus Christi as soon as the depth of the channel is increased to 30 ft. It is expected that the deepening of the channel will be accomplished within the next few months. When this is done, ocean-going vessels of larger draft will be able to come to the docks at Corpus Christi for their cargoes. Corpus Christi has a very well protected harbor. It possesses the advantage of being the first Texan port north of the Mexican border. It is expected that American Metals and other large producers of minerals in Mexico will use Corpus Christi as their export and coastwise deep-water outlet, in addition to American Smelting & Refining.

New Gold Coast Harbor to Be Opened April 3

Work on the deep water harbor at Takoradi, Gold Coast, which has been in the process of building for the last five years, has practically been completed, and the harbor will be formally opened April 3, according to the Department of Commerce. The new harbor at Takoradi should have an important influence on the bauxite and gold production of the Gold Coast. Cost of the undertaking, all taken from the revenue of the colony itself, amounts to £3,250,000.

Men at work on the outcrop of the McRea-Lefler strike in Wahmonie, Nevada's new silver-gold camp

One Strike of Real Importance Made at Nevada's New Camp

WAHMONIE, the latest silver-gold boom camp of Nevada, continues to increase in size. The camp has a population of two hundred people already, and visitors are arriving daily. Only one strike of any real importance has been made to date, and that is the McRea-Lefler. It is situated at the base of a small hill, in rolling country, about 6 miles west of the edge of Forty Mile Canyon. The Forty Mile district is about 50 miles east of Beatty, Nev.

The outcrop of the McRea-Lefler is not prominent. It has been developed for a distance of 100 ft. by trenching with other more remote work along the strike disclosing some values. Very little real work has been accomplished; so little, in fact, that the width of ore is as yet undetermined, and the depth is an unknown quantity. The owners have granted leases in 100-ft. blocks, on reasonable royalties, and, as 30 shifts per month is required to hold a leasing block, the extensions of the known section showing values may soon be developed.

Although no other strike of comparable importance has been made in the district, a number of prospectors are combing the hills. The country is staked for miles in all directions. It is yet too early to comment either favorably or unfavorably on the merit of the new camp, and opinions are being withheld for the time. Many good mines have had small beginnings, and Wahmonie is entitled to consideration as a likely prospect, with the possibility of becoming a mine.

The accompanying illustrations were taken about three weeks after the original discovery. They show the small tent city that has sprung up in the midst of the typical Nevada desert, and work on the McRea-Lefler strike.

The camp at Wahmonie, 50 miles by road from Beatty, Nev.

Central Hudson G. & E. Donates $10,000 to Fund of Engineering Foundation

A CONTRIBUTION of $10,000 to the endowment fund of Engineering Foundation has been authorized by the board of directors of the Central Hudson Gas & Electric Corporation. "It represents $10,000 of return premiums paid during the past year on accident insurance, as the result of the company's excellent record in preceding years," says T. R. Beal, president of the corporation, in the letter announcing the gift, addressed to Alfred D. Flinn, secretary of the United Engineering Society.

McCrea Introduces Bill for Protection From Silicosis

Charles McCrea, Ontario minister of mines, has introduced a bill in the provincial legislature to provide for the protection of underground workers in Ontario mines against silicosis. In those mines where conditions are inducive to the disease, the bill would provide a medical examination for all underground workers at least once a year. Workers without certificates proving that they are free from the disease would not be permitted to accept employment underground.

Bureau of Mines to Make Economic Studies of Non-Metallic Minerals

THE WORK of the Rare Metals and Non-Metals Division in the Economics Branch of the U. S. Bureau of Mines is to be expanded by increasing its activities in the non-metallic minerals. A special section having to do chiefly with the structural non-metallics, such as stone, cement, brick and tile, sand and gravel, lime and gypsum, is being organized. Oliver Bowles, formerly supervising engineer of the Non-metallic Minerals Experiment Station, at New Brunswick, N. J., has been placed in charge of this section, with J. R. Thoenen, mining engineer of the New Brunswick station, as assistant. The work will be centered in Washington, D. C.

Structural non-metallics and their primary products have a total annual production value in the United States of approximately one billion dollars, and, through their extensive use in all types of buildings, public works, highways and railroads, their influence touches the life of practically every community and every individual. Intensive study directed toward such business problems as systematized cost keeping, distribution of products, transportation, a better knowledge of markets, market requirements, extension of uses, and similar features that have an important bearing on the healthy prosperity of any industry would benefit not alone the non-metallic industries that occupy so important a place in the economic life of the country, but should be of undoubted indirect benefit to all industries that consume their products and to the public at large.

Silver Discovered at Island Lake in Manitoba

Importance is attached to a discovery of native silver, made at Island Lake, which is about 150 miles due north of Red Lake, Ontario. The discovery was made by Kenneth Murray, brother of Gordon Murray, who staked the gold discovery which attracted widespread interest some years ago at Elbow Lake, in northern Manitoba.

Island Lake is north of Sioux Lookout about 250 miles as the crow flies, and is well over 300 miles northeast of Winnipeg. The scene of the discovery, though 150 miles north of Red Lake in Ontario, is in the province of Manitoba, owing to the fact that the boundary between Ontario and Manitoba runs northeast of this section and not straight north, as in southerly parts of the boundary.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Kirkland Lake Developments Disclose Additional Tonnages

TORONTO, MARCH 10, 1928.—Three of the important Kirkland Lake companies, Kirkland Lake, Teck-Hughes, and Lake Shore, have recently found new orebodies or extensions of old veins. At the 2,725 level of the Kirkland Lake mine, a vein which was recently intercepted in the crosscut has been drifted on for a length of 25 ft. Reports put the assay as high as $35 a ton across good widths. To the east of the crosscut, a drift has entered another orebody averaging $10. The new values at Teck-Hughes are being found on the 13 level. Stopes have been opened up for a length of 80 ft. over a width of 67 ft. Ore taken from these stopes averages $20 a ton, which is $2 more than the average for the entire mine. At present the Teck-Hughes mill is treating about 850 tons a day, of which 600 tons is treated by the new mill. Lake Shore No. 2 vein has been cut on the 1,400 and 1,600 levels recently, thus proving it at three levels below 1,000 ft. Only a limited amount of work is being done on these levels, but it shows that both widths and values of the ore are being maintained. Another tube mill was installed recently at the Lake Shore, and it is expected that the tonnage treated will again be increased.

POLICE OFFICIALS in Quebec raided a brokerage house in Montreal last week and arrested three men—Ferdinand Lundenau, Ralph Mott, and Paul Newman. They are charged with conspiracy to defraud the public of $200,000 in mining-stock operations during the last two years. The organization was principally engaged in selling shares of a number of mining companies.

The Mandy mine, which practically adjoins the Flin Flon, is now making strenuous efforts to get all supplies in before the break-up. The holdings of the company were recently increased, and now amount to 1,300 acres, which carries the boundaries of the property to the Flin Flon line. The reports on the property stated that there were 100,000 tons of ore, having a high gross value to the ton. It is understood, however, that preliminary survey indicates an additional 100,000 tons of lower-grade ore. The first work to be done will be to sink the shaft from the 200 to the 400 level, and a large amount of diamond drilling will also be carried out.

Work on the two shafts at the Sherritt-Gordon property, in northern Manitoba, is progressing. These shafts are 1¼ miles apart. No. 1 shaft, at the east end, is down 65 ft., but No. 2 is down only a few rounds. It was first decided to put both shafts to 500 ft. and then come back and open up the different levels. It has now been decided, however, to open up the levels and keep on sinking at the same time, and it is hoped that at least one of the two shafts will be down to the 1,000 level this fall. At the No. 1 shaft a cement collar has been put in and a 75-ft. headframe is being erected. A permanent plant is being installed. Recent diamond drilling has increased the known length of ore, until at present 9,000 ft. has been proven. A big effort is being made to get the supplies into the property by the middle of March.

Those responsible for the management of the Arno Mines of Quebec, which are in the same section as the Abana, report that the first diamond-drill hole shows favorable results.

London Letter

BY W. A. DOMAN
Special Correspondent

Investors in Russian Mines Are Hopeful as Soviet Changes Attitude

LONDON, FEB. 28, 1928.—Reports that the Soviet authorities are anxious to be on friendly terms with other nations are becoming more frequent. It is evident from such information as is obtainable that the Russian government realizes that the country cannot be developed without capital. This, of course, has been recognized by the rest of the world for some time, but the extremists, in their rise to power, imagined that Russia was self-contained and could exist without external intercourse. Now, not only are the interests of the bondholders to be discussed, but also those of companies that have been deprived of their properties. French investors entertain renewed hopes; and though there seems a reluctance to release oil fields, which are easily worked and the product of which is readily sold, the prospects of mining companies appear to have brightened. Lena Goldfieds has received the greatest amount of attention. A notice has been circulated that the nominal value of the shares is to be reduced from £1 to 10s., thus providing the means for raising much-needed additional capital. It is reported that the Soviet will presently grant permission for some other of the company's large areas to be worked.

JAMES FAIRBAIRN, who controls both rubber and tin properties in Nigeria, is to make a statement in regard to the tin situation soon. In the meanwhile, preparation for the amalgamation of some of the tin interests is being made. Associated Tin Mines of Nigeria will hold a meeting on Friday to raise the capital from £200,000 to £1,000,000 in 5s. shares.

Melbourne Letter

BY PETER G. TAIT
Special Correspondent

Urquhart Expects Mount Isa to Be World's Largest Lead-Silver Mine

MELBOURNE, FEB. 10, 1928.—Leslie Urquhart, chairman of Russo-Asiatic Consolidated, after his return to Cloncurry from a trip of inspection, expressed himself as much pleased with developments at Mount Isa, the large low-grade silver-lead property in Queensland in which Russo-Asiatic recently obtained a controlling interest. He said he was satisfied that estimates of 20,000,000 tons of ore in the Black Star lode were correct, but he also made it clear that the undertaking depends largely on the cost of transportation, as the ore is low-grade. To this end he will confer with provincial officials at Queensland. If satisfactory terms are arrived at, the company will start work immediately on a big dam at Rifle Creek, 18 miles south of Mount Isa. A pipe line to the mines is also included in the plans for this undertaking, which will cost, according to estimates, about £100,000. The first unit of the plant will treat 2,000 tons daily. According to Mr. Urquhart, everything should be in full swing by 1930. In all, there will be three units, together with lead and zinc refinery, calling for a total expenditure of almost £4,000,000.

THE MINING warden at Cloncurry reports that representatives of Mount Elliott, Ltd., inspected the Mount Oxide mine recently and that it is possible that operations at the property will be resumed when the road is repaired so as to assure motor transportation. Leasers have been asked to supply 1,000 tons of ore a week, but unless a new lode is discovered this seems too high a figure, as the highest production in the past was 1,500 tons a month.

Electrolytic Refining & Smelting and Mount Morgan Gold Mining have sold their interests in Australian Fertilizers, Ltd., of Port Kembla, to Mount Lyell Mining, Nobel, Ltd., and Cuming, Smith & Co. Electrolytic Refining & Smelting is an offshoot of Mount Morgan, which erected a copper-refining plant at Port Kembla in 1909. Blister copper from Mount Morgan, Mount Lyell, Hampden-Cloncurry, and other mines was refined there, in addition to ores which were purchased throughout Australia. Now that Mount Morgan and Hampden-Concurry have closed down, and that Mount Lyell is erecting its own refinery, the future of the works is uncertain.

Fire recently destroyed ore bins and headframe of the main haulage shaft at the British mine, Broken Hill. Reconstruction work was immediately started and operations should be resumed soon.

Flotation-Reagent Consumption in 1926

Thomas Varley Reports That 201,711,000 Pounds Was Used in the United States to Treat 50,889,254 Tons of Ore

PROGRESS in the art of flotation, especially with respect to the reagents used, is so rapid that the proportions of the various chemicals in important use vary widely from year to year. The data for 1927 doubtless will show a very different picture from the figures given here for 1926. Nevertheless, Mr. Varley's compilation, published as Serial 2652 of the U. S. Bureau of Mines, is a valuable and significant record. It is reproduced here almost in its entirely.

In past years flotation has been referred to generally as "oil flotation"; today it might be more properly called "chemical flotation." Minerals can be floated today without oil. Chemicals alone will do the work, showing how little was truly known about the process heretofore. The term "reagents" as used herein, includes chemicals and oils.

The total pounds of oils and reagents consumed during 1926 was greater than shown in the 1925 report. The 1926 total was 201,711,795 lb., compared with 81,666,967 lb. for 1925. The equivalent in pounds of reagent used per ton of ore for 1926 was 3.963, compared with 1.7952 for 1925. This increase is due largely to the amount of lime which is added in the alkaline circuits, particularly in the mills treating copper ores, which accounts for the larger tonnages.

To counteract objectionable soluble materials present either in the ore or the mill water, modifying reagents are used to "condition" the pulp and by neutralization prevent interference of such soluble materials. Reagents of this type are soda ash, sodium silicate, sodium sulphite, crude soda, lime and acids. In this connection, lime is generally regarded as a "chemical," on account of its action on the minerals and its reactions with acidic solutions or soluble salts in the ore.

The terms "sinking" or "dropping" of minerals are now common in flotation plants, which means that chemicals and oils are added to the flotation pulps to depress the undesirable floatable minerals and raise the desirable ones. For instance, galena can be floated away from sphalerite and pyrite under proper conditioning of the pulp and addition of suitable flotation reagents. In turn, certain chemicals and oils can be added which remove the depressing action of the first reagents and render the sphalerite amenable to flotation, thereby leaving the pyrite behind. Again, other reagents can be added to float the pyrite from the gangue material.

The ratio of concentration in flotation is comparatively high, because high-grade products are constantly being obtained more free from undesirable minerals and gangue than heretofore. This is shown by the reports previously published.

Summary of the 1926 figures shows that the total quantity of ore reported as being treated by flotation in that year was 50,889,254 tons, from which 3,353,120 tons of concentrates was obtained, giving an average concentration ratio of 15.177 tons into 1. This ratio is slightly less than that for the 1925 figure, which was 16.301 to 1.

The data here summarized were collected by special canvass of mill operators. We believe that the summary is as complete as figures will permit. In

THOMAS VARLEY

some plants where gravity concentration is still in use the operators reporting have had to estimate the tonnage going to flotation. Over 95 per cent of the tonnages reported are actual figures reported to the fraction of a ton, and 5 per cent are those closely estimated by operators. There are some few operators who have not reported, but their outputs are very small and would increase the total tonnage only slightly—probably not more than 1 or 2 per cent.

Classification of Ores Treated by Flotation, 1926

	Total Treated, Tons	Treated by Flotation, Tons	Concentrate (Flotation), Tons
Gold-silver ores	525,660	525,660	28,428
Copper ores	47,635,883	43,967,496	2,389,516
Silver-lead ores	1,040,502	607,355	44,555
Lead ores	6,226,174	1,977,576	91,345
Lead-zinc-iron ores	2,692,320	2,457,811	550,987
Zinc and lead-zinc ores	7,599,216	972,584	214,707
Lead-copper-silver	125,193	125,193	14,273
Miscellaneous	255,579	255,579	19,309
Totals	66,100,527	50,889,254	3,353,120

In the general summary table for all ores as well as summaries for the different classes of ores, are shown figures for "total tonnage of ore treated," while "tonnage of concentrates treated by means other than flotation" is not shown. In many mills the ore is crushed, classified, and treated by gravity concentration, some mills discard tailings without regrinding; others regrind tailings and treat by flotation. For the reason that some of the ores milled were reported as being treated by methods other than gravity and flotation, and information relative to the several kinds of concentrates produced was lacking, it was impossible to give the concentrate tonnage figure in this report.

Table I—Summary of Data on Ore Milled and Consumption of Reagents Used in Flotation in the United States in 1926

Total number of companies reporting	145
Total ore milled by concentration, flotation, and other methods, tons	66,100,527
Total ore treated by flotation, tons	50,889,254
Total concentrates produced by flotation, tons	3,353,120
Concentration ratio by flotation	15.177 to 1
Total reagents consumed (all kinds), pounds	201,711,795
Equivalent in pounds per ton ore	3.963

Reagents	Pounds
Refined hardwood creosote	1,931,897
Sodium sulphide	7,354,844
Pine oil	5,980,311
Xanthate	3,983,118
Water-gas tar	26,414
Ammonia	33,288
Distillate	11,806
Coal tar	5,409
Sodium silicate	350,122
Refined coal-tar creosote	2,777,806
Cresylic acid	241,853
Lime	162,240,359
Crude oils	910,297
T & T mixture	124,048
Sulphuric acid	4,539,500
Cement	1,498,035
Copper sulphate	3,582,694
Soda ash	2,985,867
Zinc sulphate	928,394
Cyanide	658,345
N. T. U. oil	54,366
Sodium carbonate	164,987
Reconstructed oils	152,085
Thiocarbanilid	111,003
Sodium sulphite	495,384
A. T.	13,589
X-Y mixture	43,130
Orthotoluidine	112,721
Miscellaneous	400,123
Total reagents consumed	201,711,795

Gold-Silver Ores

Reports from six operators treating gold-silver ores were received. The ore treated by flotation totaled 525,660 tons, from which 28,248 tons of concentrates was produced, with a concentration ratio of 18.491 tons into 1, compared with 484,924 tons treated in 1925, with 36,445 tons of concentrates produced and a concentration ratio of 13.306 tons into 1.

Table II—Reagents Used for Gold-Silver Ores, Pounds

Refined hardwood creosote	235,597
Sodium sulphide	70,025
Pine oil	45,801
Xanthate	31,157
Water-gas tar	26,414
Ammonia	33,288
Distillate	11,806
Coal tar	5,409
Sodium silicate	4,700
Barrett No. 4	3,688
Cresylic acid	60
Total	467,945

Copper Ores

Twenty-four operators reported the treatment by flotation of 43,967,496 tons of copper ore for the year, from which 2,389,516 tons of concentrates was produced. This tonnage, compared with 1925 figures (40,576,067 tons treated and 2,166,557 tons of concentrates produced), shows an increase of 3,391,429

tons of crude copper treated by flotation and an increase of 222,959 tons of concentrates produced. The concentration ratio was 18.275 tons into 1, compared with 18.728 tons into 1 for 1925. Various operators reported an additional tonnage of 3,668,387 tons of ore treated by other methods such as gravity concentration and leaching; these figures are exclusive of flotation. The figures in Table III show kinds and quantities of reagents used. As will be seen, the total "pounds of reagents used" was 186,814,870, or an average of 4.2489 lb. per ton of ore treated.

Table III—Reagents Used for Copper Ores, Pounds

Pine oil	5,251,110
Xanthate	3,049,625
Lime	161,481,483
Coal-tar creosote	1,923,300
Crude oils—Scotch, blast furnace and shale oils	892,358
Sodium sulphide	6,737,579
T & T mixture	98,414
Hardwood creosote	921,858
Sulphuric acid	4,539,500
Cement	1,498,035
Reconstructed oils	152,085
Miscellaneous	269,523
Total	186,814,870

Silver-Lead Ores

The ores listed in this type include those whose principal values are silver and lead and from which no zinc is recovered. A few of the plants report a very small amount of copper in the concentrates but not enough to be commercially valuable.

Some of the plants are operating on straight sulphide ores, but the greater number are treating either straight oxidized ores or mixed sulphide and oxide ores. This accounts for the large amount of sodium sulphide used as a reagent, in which application it becomes a sulphidizing agent.

Twelve operators reported the treatment of 607,355 tons of this class of ore by flotation, from which 44,555 tons of concentrates was produced, with a concentration ratio of 13.361 tons into 1. These figures, compared with 636,628 tons treated in 1925, with 70,813 tons of concentrates produced and a concentration ratio of 8.990 tons into 1, show a decrease of 29,273 tons treated and 26,258 tons of concentrates produced. The concentration ratio for 1926 was higher than for 1925, as was also the average grade of concentrates produced.

Table IV—Reagents Used for Silver-Lead Ores, Pounds

Sodium sulphide	504,730
Sodium silicate	127,349
Pine oil	114,975
Sodium carbonate	77,700
Refined coal-tar creosotes	57,056
N. T. U. flotation oil	54,366
Hardwood creosote	42,323
Cresylic acid	14,611
Xanthate	11,712
Fuel oil	16,457
Miscellaneous oils, including No. 70, P. E. oil, zinc sulphate, lime, sulphur, Kraut oil, cyanide and a few other reconstructed oils and chemicals	80,609
Total	1,101,888

In addition to the tonnage treated by flotation these companies reported 433,147 tons treated by gravity concentration, from which 75,915 tons of concentrates was produced.

Table V—Reagents Lead Ores, Pounds

Hardwood creosote	615,551
Cyanide	263,547
Zinc sulphate	107,383
Xanthate	135,180
Cresylic acid	168,651
Soda ash	80,350
Pine oil	61,127
Copper sulphate	50,450
Lime	12,381
Thiocarbanilide	600
Total	1,495,220

Lead Ores

The ores under this classification are those comparatively free from other minerals and from which the lead content is practically the only economic value. This accounts for the relatively few kinds of reagents used.

Six operators reported 6,226,174 tons of this type of ore milled by gravity concentration and flotation during the year, from which 300,918 tons of concentrates was produced, compared with 6,120,716 tons in 1925, with 400,071 tons of concentrates produced, an increase of 105,458 tons over 1925, but a decrease of 99,153 tons of concentrates produced. This is accounted for by the higher grades of concentrates produced and by a slightly less metal content of the ore treated.

The ore treated by flotation in 1926 was 1,977,576 tons, from which 91,345 tons of concentrates was produced, with a concentration ratio of 21.649 tons into 1. This compares with 1,793,547 tons treated in 1925 and 175,713 tons of concentrates produced and a concentration ratio of 10.207 tons into 1.

The higher concentration ratio is accounted for by the lower grade of ore treated and a slightly higher grade of concentrate produced.

Lead-Zinc-Iron Ores

This type of ore represents the real complex lead-zinc-iron sulphide variety, in which the minerals are closely associated with each other as well as with the gangue material. Silver is also a valuable constituent of this type of ore. It is this class of ore on which differential separation of the minerals has been highly and successfully developed the last two years.

As a source of zinc for the electrolytic zinc smelters this material is paramount. The lead products are removed for the lead smelters, and at present zinc products are obtained assaying 50 to 57 per cent in zinc content, with recoveries up to 85 per cent of the total zinc content of the ores treated. The lead recoveries are even higher than those of zinc.

Some of the large Western smelting companies have milling plants at their smelters and treat custom ores of this variety. Proper mixing by ordinary belt conveyors makes it possible to obtain a very uniform "feed" for the mills, even when as many as seven to ten ores from different mines or districts are treated.

Desirable lead products are recovered quite free from zinc, and products high in iron are also made. These iron concentrates, which contain small amounts of lead and appreciable amounts of silver, furnish desirable iron ores for fluxing purposes, either in lead or copper smelters. The total ore of this type reported treated by 22 companies for the year was 2,692,320 tons by combined gravity and flotation. For the reason that in some plants gravity concentration precedes flotation and finished concentrates are produced both of lead and zinc, and also some tailings discarded, it is difficult to figure concentration ratios and concentrate tonnages from this type of milling. A few straight gravity concentration mills are still in existence.

The tonnage of this type of ore treated by flotation in the 22 mills for the year was 2,457,811, from which 230,937 tons of lead concentrates was produced and 320,050 tons of zinc concentrates, as compared with 1,432,264 tons treated in 1925, with 134,257 tons of lead concentrates and 168,445 tons of zinc concentrates. The concentration ratio for 1925 of the combined lead and zinc concentrates was 4.731 tons into 1; for 1926, 4.461 tons into 1.

Table VI—Reagents Lead-Zinc-Iron Ores, Pounds

Lime	163,196
Refined coal-tar creosotes	438,303
Pine oil	242,732
Sodium silicate	218,073
Soda ash	2,664,676
Hardwood creosote	115,648
Copper sulphate	2,293,196
Xanthate	381,887
Zinc sulphate	706,952
Cyanide (sodium and calcium)	217,966
Sodium sulphite	495,384
Orthotoluidine	112,721
Thiocarbanilid	87,044
Sodium sulphide	14,900
T & T (Ortho-Thio)	25,634
A. T.	13,589
Sodium carbonate	87,287
Miscellaneous (includes cresylic acid, P. E. oil, kerosene, naphthalene, carbonic acid, sodium hydrate, and a few reconstructed oils)	27,543
Total	8,306,731

A few mills make an iron concentrate which carries some silver and a small amount of lead, which is sent to the smelters for fluxing purposes. This small tonnage is not figured in the above results.

Zinc and Lead-Zinc Ores

Zinc and lead-zinc ores represent largely those found in the Middle West, particularly the Tri-State district of Missouri, Kansas and Oklahoma. The general practice is gravity milling at relatively coarse sizes, by which products of lead and zinc are obtained high in metal content.

Table VII—Reagents Zinc and Lead-Zinc Ores, Pounds

Xanthate	197,533
Pine oil	124,635
Copper sulphate	1,144,821
Cresylic acid	58,532
Refined coal-tar creosotes No. 634	258,372
Refined coal-tar creosotes No. 8	22,041
Refined coal-tar creosotes No. 22	46,242
X-Y mixture	43,130
Lime	35,285
Soda ash	52,914
Thiocarbanilid	19,402
Miscellaneous (including zinc sulphate, sodium sulphite, sodium bicarbonate, sulphuric acid, sodium hydrate, and hardwood creosote	21,717
Total	2,024,624

The natural slimes, together with the middlings, which are recrushed, are treated by flotation, and excellent recoveries are being obtained.

Some of the mills remove both a lead and a zinc concentrate, though others produce only a zinc concentrate by flotation; this is governed, of course, by the metal content of the material treated. A few mills still practice gravity concentration only.

Reports from 64 operators show that the tonnage milled in their plants for the year was 7,599,216 tons crude ore by gravity and flotation concentration. A total of 76,114 tons of lead concentrates was produced by gravity concentration and 403,686 tons of zinc concentrates produced by the same method.

The same milling plants treated 972,584 tons of ore by flotation, from which 3,224 tons of lead concentrates and 211,483 tons of zinc concentrates were produced. The concentration ratio for the combined lead and zinc was 4.594 tons into 1 by flotation.

These figures show an increase of 523,587 tons treated by flotation over the figure for 1925, which was 448,997. Such an increase surely marks progress in the metallurgical treatment of the ores in that district and materially decreases the mineral waste which naturally took place prior to the flotation installation.

Lead-Copper-Silver Ores

Lead-copper-silver ores are encountered in some places, and though few operators are now making a differential separation of the lead and copper, the greater number make a mixed copper-lead concentrate, usually high in silver.

Table VIII—Reagents Lead-Copper-Silver Ores, Pounds

Sodium sulphide	23,550
Soda ash	132,927
Xanthate	9,185
Pine oil	17,249
Refined coal-tar creosote	18,432
Lime	39,574
Cyanide	26,413
Zinc sulphate	61,559
Thiocarbanilid	3,957
Crude oil	1,482
P. E. oil	730
Total	335,058

Six operators reported the treatment by flotation of 125,193 tons of these types of ore, from which 14,273 tons of concentrates of mixed lead-copper-silver was obtained. This gives a concentration ratio of 8.769 tons into 1.

Miscellaneous Ores

Miscellaneous ores include a few complex varieties where several minerals are recovered in different products; also graphite, molybdenum, and a few of the rare mineral ores. Five operators reported the treatment by flotation of 255,579 tons, from which 19,309 tons of concentrates was produced. The concentration ratios were wide and varied.

Table IX—Reagents Miscellaneous Ores, Pounds

Soda ash	55,000
Cyanide	150,419
Xanthate	166,839
Pine oil	122,682
Copper sulphate	94,227
Lime	508,440
Zinc sulphate	52,500
Refined coal-tar creosote	10,372
Hardwood creosote	920
Sodium sulphide	4,060
Total	1,165,459

Canadian Institute Holds Twenty-ninth Annual Meeting

Gathering at Quebec, March 7, 8, and 9, Emphasizes Growth of Dominion Mining Industry—Figures for 1927 Constitute High Record—R. H. Stewart Is the New President

By George C. Bateman
Special Correspondent

HISTORIC old Chateau Frontenac, in the ancient city of Quebec, was the scene of the twenty-ninth annual meeting of the Canadian Institute of Mining and Metallurgical Engineers, held on March 7, 8, and 9. Attendance was larger than might have been expected, the technical papers were interesting, the technical sessions were well attended, and there was more interesting and intelligent discussion than usual. J. J. Warren, president of Consolidated Mining & Smelting, presided over the opening meeting. J. E. Perrault, Minister of Mines for Quebec, made the first address. Fitting reference was made to the death of the Honorable William Sloan, Minister of Mines for British Columbia, who died on March 2, and who was generally recognized as one of the outstanding factors in encouraging the mineral development of that province.

The first public announcement of the mineral production of Canada and the Provinces is always made at the annual meeting of the Institute. S. J. Cook, dominion statistician, who presented the figures for the dominion, introduced an innovation by giving a report in both English and French. The year 1927 set a new high record for mineral production in Canada, when the value of the output reached $244,520,098, an increase of more than $4,000,000. New output records for all time were established in gold, copper, lead, and zinc, among the metals, and in coal, cement, lime, and gypsum, among the non-metallics and structural materials. Metals as a group valued at $113,136,000 showed a small aggregate loss, caused by the lower prices for copper, lead, zinc, and silver that prevailed throughout the year. The chief metals in their order of importance were gold, $38,130,000; copper, $17,195,000; nickel, $15,262,000; lead, $16,412,000; silver, $12,747,000; and zinc, $10,134,000. Fuels, non-metallics, and structural materials all showed a general increase.

A. C. Young presented figures for Ontario and these also established a new high record. The value of the production amounting to $89,839,569, an increase of $4,750,000. Metallic output was valued at $62,766,000, an increase of $3,500,000, which was largely accounted for by the increased output of gold. The report records great activity in prospecting and diamond drilling. Seventy-one diamond drills were engaged in northern Ontario. More than 1,400 holes were drilled and 71 miles of core extracted.

J. D. Galloway, provincial mineralogist, presented the figures for British Columbia, which showed a total value of $60,000,000, a decrease of $7,000,000, accounted for by decreased metal prices. Of the total $44,700,000 was metallic production, including 280,000,000 lb. of lead and 144,000,000 lb. of zinc. British Columbia is the largest producer of these two metals in Canada, and practically all of this output comes from Consolidated Mining & Smelting. Mr. Galloway was optimistic about the future, stating that ore reserves were greater than ever and that the discovery and development of new properties is keeping pace with production.

A. O. Dufresne, director of the provincial Bureau of Mines, presented the Quebec figures, which showed a value of $29,211,000, an increase of $3,500,000. Of this amount $10,622,000 was represented by asbestos. These figures also include the first production of copper in the province, which came from the Horne mine.

Membership Will Vote on Increased Fees

At the business session which followed the mineral statistics there was considerable discussion regarding the proposal to raise fees from $10 to $12 a year. This matter will be settled by a ballot of the membership at large. The Leonard Medal was presented to Sir Stopford Brunton, for his paper on the gold fields of Nova Scotia. Award of student prizes was also made at this meeting.

The evening session of March 8 was devoted to geophysical methods of prospecting. Demonstrations with laboratory apparatus were made by Dr. E. S. Bieler, of the department of physics, McGill University, and by E. H. Guilford, of the Radiore Company. The discussion was led by Dr. A. S. Eve, professor of physics, McGill University, and a large number took part in it. Something in the nature of a bomb was dropped in the camp of the geophysicists by J. MacGregor, formerly geologist of the Amulet property, of Quebec, and now with the Mandy Mines, Manitoba. Mr. MacGregor is responsible for the discovery of important orebodies on the Amulet in ground which had been tested by electrical prospecting, and he criticized the geophysicists for some of the advertising which had appeared and for the claims which were made for different methods in the prospecting for minerals, particularly in northern Quebec. Mr. MacGregor's strictures seemed to be based upon the fact that the electrical companies were charging fees as experts for methods still in the

experimental stage. The consensus of opinion seemed to be that no one method was applicable under all conditions and in all fields.

Geological Research Planned

Thursday morning was devoted to discussion of the copper deposits of northwestern Quebec and their relation to the associated rocks. The geology of this district is proving to be much more difficult than at first supposed, and operators are still in the dark as to these relationships. The various papers, however, brought out the fact that the Dominion government geologists have done a large amount of valuable work and are now engaged in geological research in this area. To date about four thousand square miles have been mapped on a broad scale and the geologists are now in a position to make detail surveys and study rock and ore relationships. Some of this work is already indicating favorable localities for the exploration for deeper-seated bodies which do not outcrop.

The afternoon technical session dealt mainly with eastern Quebec and the Gaspé Peninsula. During the afternoon the meeting was enlivened by an impromptu hockey game between J. Y. Murdock's "Noranda Shareholders" and G. C. Riley's "Dynamite Users." Mr. Murdock's team was victorious, largely as a result of the brilliant play of Father Pelletier, parish priest of Rouyn.

Dr. R. C. Wallace's paper on the ore deposits of northern Manitoba proved of much interest, as did also J. D. Galloway's paper on "Mining Investments by the Public." It is seldom that so much interest has been taken in the technical sessions and so much interesting and constructive discussion developed. The committee was fortunate that at this time several different fields are engaging great attention, and these new fields in which the members are interested were featured to some extent.

Joy Unconfined

The annual smoker was held Thursday evening and, there being no legal bar to enjoyment in this province, it was, under the chairmanship of John Ness, as great a success as usual. The annual dinner, the closing function, was held Friday evening. The principal speakers were the Hon. Charles Stewart, Dominion Minister of Mines; the Hon. J. E. Perrault, Minister of Mines for Quebec, Monseigneur Deschamps, head of Laval College; John Hall Kelly, and Dr. George Otis Smith, president of the A.I.M.E. The dinner was followed by a dance, which proved to be a most enjoyable entertainment. A considerable number of ladies came from outside points, and they were well entertained by the people of Quebec, who are renowned for their courtesy and hospitality.

The Institute begins its thirtieth year with R. H. Stewart, of British Columbia, as president; Charles Williams, of the Hollinger, vice-president for Ontario, and J. G. Ross, of Montreal, vice-president for Quebec.

Northwest Mining Men Hold Successful Convention at Spokane

Thirty-third Annual Meeting Marked by Good Attendance and Lively Discussion of Current Problems—Revision or Federal Depletion Allowance and Increase of Appropriation for U. S. Bureau of Mines Demanded

By George J. Young
Associate Editor

With its usual hospitality and open-handedness, Spokane welcomed the Northwest Mining Convention on Feb. 28, 1928. The convention included the mining men of the Northwest — Washington, Idaho, Oregon, Montana, and British Columbia. This was the 33d annual meeting, a fact that attests the interest taken by the mining men in their association. Some 300 or more registered at this meeting. The representation was general. A feature of the meeting was the attendance of representatives of the Montana chapter of the Rocky Mountain Oil and Gas Association. A mineral exhibit was shown in one of the downtown stores and attracted considerable attention. More than 1,000 properties were represented.

Although there were several preliminaries on Monday, President Charles H. Goodsell opened the convention officially on Tuesday morning. After the usual addresses of welcome, including one by Roland H. Hartley, Governor of Washington, the remainder of the day was devoted to a consideration of the immediate needs of the State of Washington. From the several papers presented it appears that efforts of some of the state officials to secure appropriations for the maintenance of steam gaging and additional topographic mapping received inadequate recognition. The basic need for such work in Washington was presented. The Washington Natural Resources Association is furthering the efforts to secure legislative recognition of the necessity for sufficient funds for work of this kind.

Wednesday was devoted to petroleum. H. C. Henderson, president of the Montana Chapter of the Rocky Mountain Oil & Gas Association, presided. Governor E. J. Erickson of Montana presented an interesting account of petroleum development in Montana. He spoke about the increasing demand for petroleum products, the present overproduction, the ineffectiveness of the law of supply and demand, and the need for regulatory measures. O. I. Deschon, editor of the *Montana Oil Journal*; Theo. A. Link, oil geologist, and R. D. Kirkham, of the University of Idaho, also delivered addresses.

Metal Mines Using Airplanes Extensively

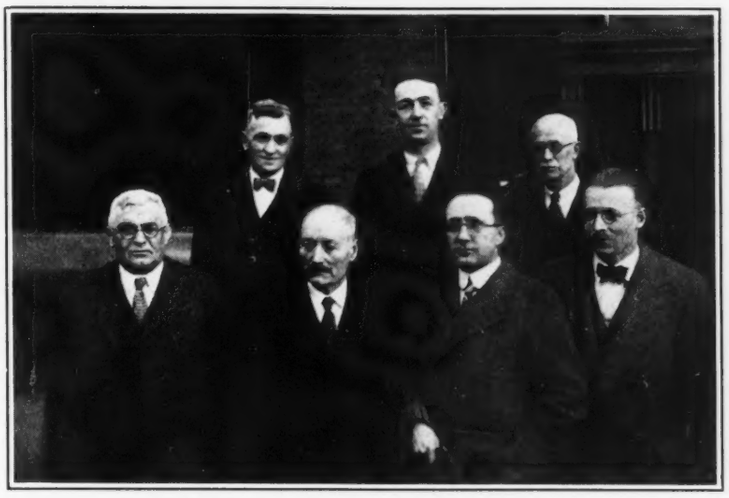
Metal mining occupied Thursday. L. K. Armstrong presided. Charles D. Garfield succeeded in convincing the members that Alaska was still in the ring. In a few words he reviewed the history of this interesting region. He described the Alaska Juneau operations, Kennecott, La Touche, and the placer operations. The work of the Fairbanks Exploration Company was mentioned and its dependence upon the railroad shown. Of most interest in overcoming transportation difficulties is the use of airplanes. Three companies have been established at Fairbanks, and six airplane transportation companies are now doing business in Alaska. Travel by airplane is reckoned in hours where formerly days were necessary. Fairbanks to Dawson required three weeks by ordinary methods of travel, but by airplane the trip can be made in six hours. Many landing fields have been established, and Alaskans have generally availed themselves of the new method of travel.

The "Outskirts of Mining"

C. E. Newton, dean of the Oregon School of Mines, said that people in an agricultural community such as Corvallis, Ore., do not know much about mining, but they are aware of the "outskirts of mining," the promotion of properties of little worth. "Mining is not the only industry thus afflicted," said Mr. Newton, "as I saw trainloads of 'fare-paid' people unloaded in Texas, and they were induced to buy irrigated lands. Promotions in mining when compared with land schemes are pretty clean. Nevertheless, in Oregon, we have 'fake assayers' and numerous dubious 'oil-well' promotions. It is the public duty of the Northwest Mining Association to cause to be put into the press a type of discussion that will cause the public to discriminate between real mining and the kind of mining that characterizes the work of the fraudulent promoter."

W. Harper said that, under the stimulus resulting from advances in metallurgy, renewed interest was being taken in mining, and the northern tier of Washington counties was again becoming a mining region. He described the methods being taken by the mining men of his locality to prevent fraudulent promotions through the operations of a local central mining council, "which investigates promotions and issues certificates only to those that comply with its requirements."

A. G. Langley, resident engineer at Revelstoke, B. C., discussed outstanding mineral developments in British Columbia. He said that outside interests are just begnining to discover that British Columbia is producing mineral wealth and that mining possibilities are as great as those in any other area upon



At the recent Northwest Mining Convention

Upper row, left to right: W. S. Hawley, chairman of the finance committee; A. W. Foster; L. K. Armstrong, manager of the convention. Bottom row: Matt Baumgartner, director; Claus Jeldness, treasurer; Leon Starmont, secretary; Dan M. Drumheller, Jr., director

the continent. Each year new areas are being made accessible by roads and trails. "A number of our companies are now well capitalized, and all they have to do is to find ore and be on their way," he said. He expressed the hope that the public's confidence will not be abused, and discussed the government's efforts to protect the public by issuing reports and checking up published statements of promotions. He gave statistics of production and touched upon the Premier mine, the Granby Consolidated, the Slocan district, and the Sullivan mine. The importance of the metallurgical plants at Trail to the mining industry was stressed.

G. B. Conway, of Helena, Mont., told about the mining history of Montana, its great mining center at Butte, its metallurgical plants at East Helena, Anaconda, and Great Falls, and more especially described mining activities in the region contiguous to Helena. He called attention to the chromite and iron-ore deposits, the cement, coal, petroleum, gas, and non-metallic minerals, and to activities in manganese mining, more especially the work of the Domestic Manganese & Development Company, of Butte, which company expects to have its 400-ton plant in operation by the middle of March.

On Friday the Columbia Section of the Institute furnished the program. Dean Francis A. Thomson of the University of Idaho presided. W. O. Howard, of Pullman, Wash., discussed present trends of metallurgy as represented in the modernization of plants, equipment, and methods. He stated that copper smelting had reached a more or less static position, but only after great improvements had been made. The advent of the sintering furnace brought about changes in lead smelting, and now economic necessity is bringing about changes in zinc smelting. As examples of improved equipment he mentioned the Symons crusher, "Tex" rope drive, duplex conveyors, new types of bearings, and pressure lubrication. In the metallurgy of copper higher-grade concentrates, direct smelting of wet unroasted concentrates in reverberatories, the smelting of copper concentrates in converters, and separation of pyrite have been responsible for the progress made. He discussed the part played by selective flotation. "The difficulties arising in custom smelters by reason of the reduction in tonnage and the changes in chemical constitution are real ones," Mr. Howard said, adding that there is a trend toward hydrometallurgical methods and that zinc retort plants had improved their metallurgy by installing McDougall type roasters for preliminary roasting and sintering machines for completing the sulphur elimination. He called attention to the reduction in amalgamating plate areas at the Homestake plant and the growing competition between cyanidation and flotation.

H. R. Banks, of the Consolidated Mining & Smelting Company, of Kimberley, B. C., read a paper prepared by C. T. Oughtred, covering flotation practice at the Sullivan mill. He said that Sullivan flotation is in its infancy, yet it has lived long enough to contract most of the diseases known to infancy, only some of which have been completely diagnosed and a panacea administered. Among many interesting facts presented he stated that the over-all steel consumption in grinding Sullivan ore to 88 per cent past 200 mesh was 1.3 lb. per ton of ore. No interruption is permitted in mill operation. This condition has been brought about by standardization upon strongly constructed, low-maintenance equipment. The mill is closed down one shift per month, and during this time all repairs and replacements are made. To make this thorough a program is prepared two weeks in advance. With respect to crushing practice he said that it is hoped to bring the ½-in. product now going to the ball mills to ⅜ and even to ¼ in. size by the use of Hum-mer screens and additional roll equipment. He especially mentioned the use of the microscope for examining pulps. He described an efficiency index represented by the sum of the lead and zinc recoveries and also one consisting of the sum of the respective grades. A bonus is paid for exceeding the standards set.

During the luncheon Dean Milnor Roberts of the University of Washington entertained the convention by an account of his European trip, which he illustrated with lantern slides.

At the afternoon session, C. R. Corey, of the University of Washington, described his investigation of a reported discovery of tin in the Cascade Mountains of Washington. The serpentine alleged to contain tin was thoroughly tested by chemical analysis, assay, and petrographic methods, but no tin was found. Efforts of parties to promote the "property" and to sell stock were finally stopped as a result of the investigations conducted by Mr. Corey.

W. W. Gail, of Montana, interested the convention in a description of the discovery, mining, and treatment of the "zonolite" which is derived from a deposit near Libby, Mont., and which is now being exploited.

Among the fifteen resolutions presented by Frank M. Smith, chairman of the resolutions committee, to the convention, the following are of most importance:

No. 3, which asks Congress for a revision of the provisions for computing depletion in the case of mining properties and advocates a percentage of income as a basis for allowing depletion.

No. 4, which expresses the strong condemnation of the convention with respect to fraudulent assays and warns the public against reports of assays and analyses that purport to show metal and mineral content unobtainable by accepted assaying and chemical methods.

No. 6, advocating increased appropriations for field stations and investigative work of the Bureau of Mines.

No. 7, asking for the repeal of the stamp tax upon stock certificates.

No. 8, seeking to provide a way by which corporation moneys acquired before the passage of the income revenue act be exempted from its provisions.

No. 10, expressing condolence in the recent death of Honorable William H. Sloan, Minister of Mines of British Columbia.

No. 14, extending an invitation to the American Mining Congress to hold a joint meeting with the Northwest Mining Association at Spokane in 1929.

A banquet, well attended, was held on Thursday evening. President Goodsell was toastmaster. Donald A. Callahan, of Wallace, Idaho, gave the address of the evening, on "The Future of Mining in the Coeur d'Alenes," and A. M. Meldrum entertained with an account of the natives of New Guinea. A smoker on Friday night and visits to near-by industrial plants on Saturday concluded the meeting, altogether an instructive, pleasurable and worth-while convention, admirably managed by L. K. Armstrong, mining engineer, of Spokane.

Book Review

Our Higher Educational Institutions

AMERICAN UNIVERSITIES AND COLLEGES. Edited by David Allan Robertson. (The American Council on Education). New York and London: Charles Scribner's Sons. Cloth; 6x9 in.; pp. 884. $2.50.

THE character, scope, and organization of higher education in the United States is reviewed in Part I of this volume. Part II presents condensed information regarding each of the universities and colleges on the accredited list of the American Council of Education. Supplementary information regarding thirteen classes of professional and fifteen classes of graduate schools is giving in Part I. For some unexplained reason, engineering schools have far less space in proportion to their number than the other schools. Thus, 130 engineering schools are given less than three pages, consisting mostly of names of schools by states, whereas twenty-five schools of economics are given eleven pages, with a list of professors, their degrees (by institutions), the subjects they teach, and, in some instances, other information as well.

The great variety of college degrees granted in America is illustrated by a list of the corresponding abbreviations used in the book, which has about 170 entries, of which 40 are courses in engineering, not including B.S. in Geodesy and Surveying or San.D. for Doctor of Sanitation. Another item of interest gleaned from the book is the hospitality shown to students from abroad by our schools and colleges. Figures for the year 1923-24 compiled by the Institute of International Education for only 400 institutions showed 6,988 foreign students. Deducting 1,332 as "unclassified," it appears that over one-fifth (1,238) of the remaining 5,656 were students in engineering, compared with 1,966 students in liberal arts, 510 in medicine, and 389 in commerce. The total number of students from over a hundred foreign countries is given for the five college years ending with 1925-26. The five countries highest in number of foreign students in American colleges for the year 1925-26 were: China, 1,317; Canada, 733; Japan, 685; Poland, 571; Russia, 515. Totals for each year are not given.

It is a great pity that after bringing together so many figures on a variety of subjects as this volume contains, practically no summaries are included. Another sad lack of the volume is an introduction in the nature of a general summary. Valuable as the book is as a compilation, it is chiefly that and nothing more. Certainly a book sponsored by educators should supply digests of the data it contains instead of compelling thousands of users to make the digests separately or do without.

M. N. BAKER.

MINING YEAR BOOK FOR 1928. By Walter E. Skinner, 15, Dowgate Hill, London, E.C.4, England. Comprises 1050 pages. Price, post free abroad, 21s. 6d.

THIS BOOK was formerly known as "Mining Manual and Mining Year Book." It contains complete and up-to-date particulars concerning 1,600 British mining companies operating in all parts of the world. Nearly 400 new companies were formed during 1927, facts regarding which are included. This volume is the latest edition of a familiar reference book which is really indispensable because it contains a vast amount of information not elsewhere compiled. To facilitate its use by non-technical readers the publisher has included a dictionary of mining terms.

ZINC METALLURGY—The February bulletin of the Institution of Mining and Metallurgy contains a discussion on H. E. Coley's paper, "A Process for the Extraction of Zinc and Other Metals from Ores," in the January bulletin. In the course of this discussion various members expressed their disappointment that Mr. Coley had not given more details regarding his process.

TIMBERING, VENTILATION.—The Feb. ruary bulletin mentioned in the preceding paragraph also contains an article by R. S. H. Richards on "Mine Timbering at the Bawdwin Mine" in Burma; likewise remarks by J. P. Rees on "The Measurement of Low Air Velocity in Mines."

FLOTATION—The February issue of *The Mining Magazine* contains the concluding installment of "Notes on Flotation Practice in Canada," by Bernard W. Holman.

TIN—The *Mining Magazine* for February also contains a one-page description of a tin dredge designed by Messrs. Cutten Bros. for the Bangrin Tin Dredging Company, Siam. Two plates show the plan and elevation of the dredge.

STEAM SHOVELING—The February issue referred to in the preceding paragraph also contains an article "Steam Shovel Mining in Nigeria," by H. R. Cope Morgan, Manager of the Mongu Tin Mines, Ltd.

GEOLOGY, CANADA—The *Canadian Mining Journal* for Feb. 24 publishes an article entitled "Copper, Zinc, and Gold Deposits of Manitoba," by R. C. Wallace; also one on "Woman and Narrow Lakes Gold Area, Ontario," by J. W. Greig.

GEOLOGY, QUEBEC—Recent developments in Gaspé Peninsula, Quebec, are described by F. J. Alcock in a paper presented at the recent meeting of the Canadian Institute of Mining and Metallurgy.

SOUTH DAKOTA GEOLOGY—The January issue of the *Black Hills Engineer*, published by the South Dakota State School of Mines, contains an article on "Geology of the Southern Black Hills," by J. P. Connolly, of the school's faculty.

PERU, MINING—Part 3 of the report of the Peruvian Department of Mines on the mining industry in that country in 1925 has been received. It covers fuels and non-metallic minerals.

ALKALINITY—The American Cyanamid Company has issued a "Technical Paper No. 11," covering hydrogen ion concentration and its control in the flotation process. Seven pages.

PATENTS

FILTER. No. 1,659,699. Feb. 21, 1928. E. L. Oliver, assignor to Oliver Continuous Filter Company.

A rotary filter having new features.

PUMPS. No. 1,659,771. Feb. 21, 1928. Charles H. Fox, Cincinnati.

A pump comprising a pair of intermeshing liquid-pumping gears operatively positioned in relation to casing, and other features.

PYROMETER. No. 1,659,804. Feb. 21, 1928. R. P. Brown, assignor to Brown Instrument Company, Philadelphia.

CONCENTRATOR. No. 1,659,935. Feb. 21, 1928. Walter Young, Los Angeles, Calif., assignor to M. E. Young.

Actuating mechanism for a dry ore concentrator of the table type.

TUNNELING MACHINE. No. 1,659,-942. Feb. 21, 1928. A. E. Carlson, Los Angeles.

COPPER REFINING. No. 1,660,220. Feb. 21, 1928. A. G. De Golyer, Brooklyn.

A method of refining copper, producing a metal entirely free from dissolved gas and free from oxygen compound.

MAGNETIC SEPARATION. No. 1,660,-362. Feb. 28, 1928. Francis M. Simonds, assignor to A. Fillmore Hyde, New York, N. Y.

A process and apparatus for separating magnetic from non-magnetic particles.

ROCK DRILL. No. 1,660,509. Feb. 28, 1928. George W. Hulshizer, assignor to Ingersoll-Rand Company.

The oscillating valve of a rock drill.

ROCK DRILL. No. 1,660,528. Feb. 28, 1928. Frederick W. Rudlin, assignor to Ingersoll-Rand Company.

Features of the valve mechanism of a hammer drill.

AIR CLASSIFIER. Nos. 1,660,682-3-4-5-6-7. Feb. 28, 1928. Albert H. Stebbins, Los Angeles, Calif.

Six patents covering the features of an air classifier for multiple treatment of fine materials.

HOIST. No. 1,660,761. Feb. 28, 1928. R. C. Osgood, assignor to the Sullivan Machinery Company.

METALLURGY. No. 1,660,884. Feb. 28, 1928. Arturo Amenabar Ossa, Santiago, Chile.

Process of manufacturing metals and chemicals by means of iodine.

Personal Notes

P. J. FLYNN is making examinations in the Cold Lake area of northern Manitoba.

H. J. C. CONOLLY, government geologist of British Guiana, is in New York at present.

FRED B. ELY has just returned to New York from Venezuela after a stay of three months.

A. C. SPENCER, of the U. S. Geological Survey, has gone to Santa Rita, N. M., to study developments in the district.

C. H. BENEDICT, chief metallurgist for Calumet & Hecla Consolidated, and Mrs. Benedict have left for Europe on a tour.

AUSTIN MCVEIGH, of Winnipeg, Manitoba, is investigating possibilities in the Reindeer Lake district of northern Manitoba.

WILLIAM DOBBIN has been appointed mine manager at the Keeley Silver mine, in South Lorrain, to succeed M. C. H. LITTLE, resigned.

H. J. C. MACDONALD sailed for Russia on March 10 on the S. S. "Majestic" to develop low-grade copper mines in the Ural Mountains.

JOHN M. FOX, California mining engineer, is making an extended trip on professional business through Nevada, Utah, Colorado, and Texas.

H. W. SUTHERLAND has been appointed Minister of Mines for British Columbia, to succeed the Hon. William Sloan, who died on March 2.

G. HILDRICK SMITH, formerly manager of Nourse Mines, and more recently engaged in construction work in Spain, has returned to Johannesburg.

H. V. BURGARD has been retained as consulting engineer by the Economy Equipment Company and the Engineering Equipment Company, both of Los Angeles, Calif.

RALPH S. ARCHIBALD, consulting geologist of Negaunee, Mich., is to direct the work of the Inland Steel Company at the properties recently optioned near Ishpeming, Mich.

SEYMOUR G. OLDSTEAD, Utah mining and construction engineer, is in Manitoba with General Engineering, assisting with the development of plans for the Flin Flon concentrator.

N. O. CARPENTER, formerly manager of the Blue Quartz Gold Mines, has been appointed to take charge of development of the Stabell property in the Harricanaw area of Quebec.

C. A. HEILAND, of the Colorado School of Mines, recently addressed the Rocky Mountain Association on the theory and operation of the torsion balance. Dr. Heiland is professor of geophysics.

THOMAS F. DONNELLY, mining engineer with the Mines & Petroleum Engineers, 135 Broadway, has returned to Mexico. He expects to stay there about six months examining properties near Matehuala, San Luis Potosi.

E. W. R. BUTCHER is chairman of the executive committee which is in charge of the arrangements for the annual meeting of the Lake Superior section of the National Safety Council, to be held in Duluth, Minn., this summer.

EDGAR Z. WALLOWER has been elected president of the newly formed Evans-Wallower Lead Company, which is a

EDGAR Z. WALLOWER

combination of Golden Rod Mining and Evans Lead. Mr. Wallower had been president of Golden Rod for some time previous to the consolidation.

W. T. SAMPSON, formerly connected with Hollinger Consolidated and the Argonaut, has been placed in charge of exploration and development work on the property of the Laval Quebec company in the Serpent Basin area of northern Ontario.

JAMES B. COGSWELL, mining engineer, has recently been appointed superintendent of the Mexican Premier mine, at Mazatlan, Mexico. Mr. Cogswell was formerly connected with the Montana-Idaho Copper Company, of Winston, Mont.

KUNO DOERR, of El Paso, Tex., who recently resigned his position as manager of smelters of the A. S. & R., southwest division, is to be associated with Karl Eilers, 233 Broadway, and will established his residence in New York City in the near future.

R. T. STAFFORD has been appointed assistant manager of the electrical department at Pittsburgh of the Allis-Chalmers Manufacturing Company. JOHN ALBERTS has been appointed district manager of the Seattle office of the same company, succeeding Mr. Stafford.

GEORGE OTIS SMITH, Director of the U. S. Geological Survey and recently-elected president of the A.I.M.E., has accepted an invitation to deliver the annual commencement address at the graduation exercises of the Colorado School of Mines in May. The 1927 address was delivered by T. A. Rickard.

J. W. ADY has recently returned to the position of general manager of the Portland Gold Mining Company. CLAYTON KISSELL, formerly superintendent of the Elkton and other Cripple Creek mines, has been appointed superintendent of Portland Gold to succeed FRED JONES, resigned.

C. H. BAXTER, of Houghton, Mich., president of the Lake Superior Mining Institute, recently made an announcement that the proposed visit of the institute to the Tri-State lead and zinc district has been postponed. A local meeting will probably be held on the Menominee range this summer.

LEON S. MOISSEIFF, president of the Russian Association of Engineers, will deliver a talk, in English, on "Steels Used for Modern Bridges," at the Engineering Societies Building, 29 West 39th St., New York City, on March 30. Admission is free to all who are interested. The address will be delivered at 8:30 p.m.

LESTER S. GRANT, dean of the faculty of the Colorado School of Mines, at Golden, Colo., has sent in his resignation, effective Sept. 1, 1928. He was given a year's leave of absence last September so that he might investigate a property in Texas. In sending his resignation, he stated that he prefers to continue as manager of the McElroy ranch in Texas. Dean Grant graduated from the Colorado School of Mines in 1899. His professional work carried him to Peru for a number of years. He also did some work in Colorado and California. He was made a professor of mining at his alma mater in 1919.

S. C. ELLS, mining engineer of the Mines Branch of the Canadian Department of Mines, has been made a fellow of the Royal Geographic Society of London. He is the tenth living Canadian to receive this honor. Mr. Ells is best known in connection with his exploratory work in northern Canada. His work in the development of deposits of bituminous sands in northern Alberta has been recognized as of the utmost importance to increased use of asphalt paving. Mr. Ells is a member of a number of geological, research, and mining societies, including the Canadian Institute of Mining and Metallurgical Engineers.

OBITUARY

CHARLES DAVIS MASON, secretary of the Cleveland-Cliffs Iron Company, died in Cleveland on March 7. Mr. Mason was 54 years old.

JOHN MUNRO, for many years business manager of the Johannesburg Consolidated Investment Company, Ltd., died recently in Johannesburg at the age of 77.

STATISTICAL NOTES

BWANA M'KUBWA COPPER MINING COMPANY, LTD., of Africa, made a new high record of production in January, 1928, when 621 short tons of copper was produced. This compares with 504 tons in December, 1927. Monthly production rate is expected to be more than 1,000 tons when alterations and additions to the company's metallurgical plant are completed.

LAKE SUPERIOR iron-ore consumption during January was 4,303,132 gross tons. This is an increase of 311,033 gross tons over the tonnage consumed in December. Consumption during January, 1927, was 4,523,863 gross tons.

ALASKA JUNEAU continued to work high-grade ore in February, under favorable weather conditions, and results for the month will probably show earnings in excess of those secured in January, when a surplus of $85,650 was reported, after the deduction of operating expenses, interest charges, and development work. The Alaska Juneau workings are in a district subject to extreme weather fluctuations. Heretofore it has been necessary to mine only the lower-grade areas during periods of unfavorable climatic conditions. The newest high-grade areas are in zones that are freer from these weather restrictions.

RAND MINES, LTD., has posted its 49th dividend of 50 per cent, and is paying to holders of its certificates for "American" shares (each such certificate representing 2½ ordinary shares deposited) $1.52 per "American" share, the equivalent of such a dividend at the current exchange rate.

CONSOLIDATED MINING & SMELTING COMPANY OF CANADA, LTD., reports the following ore receipts at the Trail smelter for the period Feb. 22 to Feb. 29, 1928:

Name of Mine	Class	Locality	Tons
Allenby	Copper	Allenby	819
Bell	Lead	Beaverdell	49
Beaver	Lead	Beaverdell	30
Canadian group	Lead	Sandon	21
			100
Daybreak	Milling	Zwicky	36
Mountain Chief	Milling	New Denver	39
Standard	Milling	Silverton	47
Whitewater	Milling	Retallack	118
			240
Goodenough	Dry	Ymir	169
Insurgent	Dry	Republic	151
Mountain Lion	Dry	Republic	32
Quilp	Dry	Republic	169
Surprise	Dry	Republic	154
Yankee Girl	Dry	Ymir	337
			1,012
Duthie	Zinc	Smithers	37
Minitor	Zinc	Three Forks	31
			68
Company mines			12,066
Total			14,305

MEXICAN MINE production in 1927, of all metals except gold and antimony, was greater than in 1926, according to statistical compilations just released by the Mexican Department of Mines. Silver production totaled 3,110,000 kg., an increase of 1.75 per cent. Gold production decreased 5.96 per cent and antimony decreased 34.7 per cent. Production of copper was 5.04 per cent higher than in 1926, and quicksilver was up 71.74 per cent, with a total of 78,000 kg. The Mexican Mining Department granted 415 concessions in 1927, many of which were taken out by foreigners for exploration purposes. Total area of lands affected was 7,771 hectares.

EXPORTS of potash from the mines of Suria, in the Barcelona consular district, to the United States in 1927, amounted to 18,534,059 lb. of potash salts, valued at $345,804, compared with 1,353,996 lb., valued at $24,714, in 1926.

World's Production of Tin Ore in Terms of Metal

In Tons of 2,240 Lb.

	1926	1927
United States	7	.....
Bolivia (a)	29,573	(b) 33,800
Great Britain	2,327	(b) 2,400
China	6,800	4,000
Japan	400	400
India	1,798	2,000
Federated Malay States (a)	45,946	(b) 52,200
Unfederated Malay States (a)	2,000	2,000
Siam	7,487	7,500
Dutch East Indies	33,006	(b) 35,300
Australia	2,860	(b) 2,800
Nigeria	7,042	(b) 7,700
Swaziland	133	150
Union of South Africa	1,083	(b) 1,200
Other countries	2,500	2,700
Totals	142,962	154,150
Monthly rate	11,914	12,848

(a) Exports. Content of Bolivian concentrates is estimated at 55 per cent. The data for 1927 marked (b) in the above table are as reported, either precisely or closely estimated. The other figures are based on the 1926 totals, consideration being given to factors which might have produced increase or decrease.

ONTARIO DEPARTMENT OF MINES shows January production of $2,983,000 in Porcupine and Kirkland from 377,159 tons of ore. The production compares with the 1927 monthly average of $2,784,000. Porcupine mines treated 294,343 tons and recovered $1,956,969, an average of $6.65 per ton. Kirkland Lake mines treated 82,816 tons and recovered $1,026,386, an average of $12.40 per ton. January production in Porcupine is a decrease of $17,000 compared with the average monthly production of 1927, whereas the Kirkland Lake January production shows an increase of $216,000 compared with the average for 1927.

INSPIRATION CONSOLIDATED COPPER COMPANY will deposit $500,000 face value of five-year 6½ per cent gold notes with the Guaranty Trust Company of New York, instead of $500,000 in cash. Article 4 of the indenture gives company the privilege of depositing on March 1, 1928, and annually thereafter, either cash or bonds to the face value of $500,000. If a premium has been paid for the bonds, the trustee is empowered to accept the bonds at the price actually paid by the company for them to a total of $500,000, provided that the premium paid has not been over 2 per cent. All such bonds must be cancelled by the trustee and not reissued.

PREMIER BORDER GOLD MINING COMPANY, LTD., and the Old Colony Mines, Ltd., are recent mining incorporations in Canada. The former is vested with power to carry on mining operations in all parts of Canada. It will have a capital stock of 2,500,000 shares without par value. Headquarters will be in Winnipeg, Manitoba. The Old Colony Mines, Ltd., has been granted a federal charter to acquire, explore, and develop mineral lands and generally to carry on the business of a mining, milling, reduction, and development company. The capital stock of the company is 6,000,000 shares without par value. Headquarters will be in Toronto.

SILVER STOCKS in Shanghai on Feb. 23 totaled 110,200,000 taels, according to cabled advices from the Shanghai office of the U. S. Department of Commerce. Of this amount 67,300,000 taels were held in native banks. The figures for the previous week were 109,800,000 taels and 69,800,000 taels respectively. Sycee bars were valued at 50,100,000 taels, which represent a decrease of 5,900,000 taels since Feb. 16. The actual number of dollar coins were 83,700,000, being an increase of 1,300,000 since Feb. 16.

TRANSVAAL GOLD output for the month of December was 851,225 oz., having a value of £3,615,774. This is an increase over the record for November of 3,166 oz., valued at £13,448. The total gold output of the Transvaal for 1927 reaches 10,130,630 oz., valued at £42,502,852, which is a record. This 1927 total shows an increase over the production for the previous year of 167,778 oz., equal in value to £757,482. Rhodesia mineral production for November was valued as follows: Gold, £200,481; silver, £748; coal, £37,080; chrome ore, £21,940; asbestos, £170,349; mica, £1,605; diamonds, £150. Total £432,353. October total, £285,062.

CHILEAN NITRATE plants in operation in 1927 increased from 25 at the first of the year to 55 in November. The fear that the Chilean nitrate industry would be unable to withstand the competition of the synthetic nitrogen product seems to have been without warrant. Tons of nitrate exported from Chile during corresponding months of 1927 and 1926 is shown in the following table:

	1927	1926
July	235,000	133,000
August	244,000	122,000
September	205,000	85,000
October	261,000	129,000
November	275,000	127,000
December	303,000	98,000
Six months' total	1,523,000	694,000

According to the scale of present operations, nitrate exports for 1928 are estimated at 2,700,000 tons, which is the amount, approximately, exported during 1913, the last pre-war normal year for nitrate exports.

The Market Report

Another Active Week in Copper and Lead—Better Business in Zinc

New York, N. Y., March 14, 1928.—Buying of both copper and lead has been in excellent volume in the domestic market during the week ending today. Likewise, there is more interest in zinc, though dealers have been the most important buyers. Most of the copper changed hands on the basis of 14.125c., Connecticut, but the demand slackened yesterday and today, and some sellers have accepted lower prices. Though there is little quotational change in lead, the tendency to shade the Smelting company's price in New York has disappeared; on the contrary, slight premiums have been obtained on some sales. Prices for zinc are a little higher, and the same applies to antimony. Tin and quicksilver prices are a little easier.

Daily Prices of Metals

Mar.	Copper	Tin		Lead		Zinc
	Electrolytic, N. Y.	99 Per Cent	Straits	N. Y.	St. L.	St. L.
8	13.90@13.925	51.00	51.375	6.00@6.025	5.80@5.825	5.60
9	13.875@13.90	51.00	51.25-51.375	6.00	5.80	5.625
10	13.875@13.90	50.875	51.25	6.00	5.80	5.65
12	13.85@13.90	50.375	50.875	6.00	5.80	5.65
13	13.80@13.85	49.625	50.25	6.00	5.80	5.625@5.675
14	13.80@13.85	49.875	50.50	6.00	5.80	5.65
	13.869	50.458	50.927	6.002	5.802	5.638

Average prices for calendar week ending March 10, 1928, are: Copper, 13.854; 99 per cent tin, 51.104; Straits 51.510; N. Y. lead, 5.994; St. Louis lead, 5.790; zinc, 5.563; and silver, 57.146.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; i.e., delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted, and prices at so-called Middle West destinations, 0.325c. above.

Quotations for copper are for ordinary form of wire bars, ingot bars, and cakes. For ingots an extra 0.05c. per pound is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Mar.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3M	Spot	3M	Spot	3M
	Spot	3M							
8	61 1/8	61 1/16	66 1/2	230 1/8	232 1/2	20 1/8	20 1/2	25 1/4	25 1/8
9	61 5/16	61 3/16	66 1/2	229 1/2	231 3/4	20 3/16	20 1/2	25 3/8	25 1/4
12	61 7/16	61 5/16	66 1/2	228 7/8	231 1/4	19 7/8	20 5/16	25 5/16	25 1/4
13	61 3/16	61 1/16	66 1/2	224 1/2	226 3/4	19 13/16	20 5/16	25 1/8	25
14	61 3/16	61 1/16	66 1/2	225	227 1/4	19 13/16	20 1/16	25 1/4	25 1/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Mar.	Sterling Exchange "Checks"	Silver		Gold London	Mar.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
8	4.87 3/8	57 1/8	26 3/16	84s11 1/4d	12	4.87 1/2	57 3/8	26 5/16	84s11 1/4d
9	4.87 1/2	57 1/8	26 3/16	84s11 1/4d	13	4.87 1/2	57 1/4	26 3/16	84s11 1/2d
10	4.87 1/2	57 1/8	26 1/4	.....	14	4.87 3/8	57 1/4	26 3/8	84s11 1/2d
					Avg.		57.208		

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cents premium.

Good Week in Copper

Sales of copper in the aggregate have been very good. This makes the third week of good business, with the one just ended the best of the three. However, the demand seems to have slackened up in the last two days. Up to and including Monday the prevailing prices were 14.125c., Connecticut, and 14.25c. in the "Middle West." A considerable tonnage was for delivery close to the refinery, reported at 14.05 and 14.075c. At the same time scattering sales were made at figures as low as 14c., Connecticut, last Friday; and yesterday a large tonnage was sold at 14.025c. The big primary producers feel that their long wait for business at 14.125c. has been justified, and with the good volume of sales at that level in the last ten days, their position has been materially eased. They are still firm at 14.125c. and small sales have been made at that level even today.

Foreign business continues satisfactory at 14.50c. c.i.f.; almost 25,000 tons is reported for the first half of the current month. Statistics for February show deliveries of 73,789 tons to domestic consumers and 60,603 for export. Though a short month, the total of 134,392 tons makes the largest total deliveries for any month in the last two years. Refined stocks in North and South America during February declined 9,544 tons, but his was a little more than offset by an increase in blister.

Zinc at 5.65c.

More activity is reported in the zinc market than for several weeks, though much of the buying is attributed to dealers. Prices are a little firmer, with a small premium for forward positions. The following figures in tons of 2,000 lb. are reported for February by the American Zinc Institute:

Stock, Feb. 1	42,163
Produced	50,042
	92,205
Shipped	50,888
Stock, Feb. 29	41,317
Metal sold, not yet delivered at end of period	26,198
Average number of retorts operating during period	72,216

Lead Exceptionally Active

An even more active week than the one preceding it is reported by sellers of lead, though the demand was stronger in the East than in the Middle West market. Last Thursday and Friday a fair quantity brought 6.05c., but Eastern business has been virtually all at the contract price of the American Smelting & Refining Company, maintained at 6c. The prevailing price in the St. Louis market was 5.80c. though

there, too, some premium business was done. London has declined and spot is below £20, with a small contango for three-month metal. In the domestic market business has been well distributed among large buyers and small, and between the consuming industries, except for the fact that storage-battery makers have been less prominent.

Straits Tin at 50c.

On March 12 Straits tin broke through 51c., but domestic buyers declined to enter the market to any great extent, and as a consequence London declined further. Subsequent declines brought out considerable buying by domestic consumers and dealers. At 50¼c. the price was lower than at any time in three years. Straits for May and June commands a slight premium. Prices for 99 per cent continue strictly nominal in the absence of any business.

Silver in Good Demand

The silver market continued quiet, with small volume of business the first half of the week, when better rates from India improved the tone slightly. Buying from this source advanced the price on March 12 to 57⅜c., and the market closes steady with a good demand.

Mexican Dollars (old Mexican pesos): March 8th, 9th, and 10th, 43¾c.; 12th, 44c.; 13th, and 14th, 43⅞c.

Foreign Exchange Steady

Sterling, as well as other foreign exchanges, has been steady. Closing cable quotations on Tuesday, March 13, were: francs, 3.93½c; lire, 5.28¼c.; and marks 23.91c. Canadian dollars are ⅜ per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

ALUMINUM—Per lb., 98 or 99 per cent grades, price of leading interest, 24.30c.; outside market, 23.90@24.30c.

ANTIMONY—Per lb., duty paid. New York: Chinese brands, for all positions, 10⅜c.

Cookson's "C" grade, spot, 15⅜c. Needle antimony nominally 7¼c. for lump and 10c. for powdered. White oxide, Chinese, 99 per cent Sb_2O_3, 11¼c.

BISMUTH—Per lb., New York, in ton lots, $2.10. Smaller lots, $2.25 and up.

IRIDIUM — Per oz., $290@$320 for 98@99 per cent sponge and powder. Market dull, prices largely nominal.

NICKEL—Per lb. ingot, 35c.; shot, 36c.; electrolytic, 37c. (99.9 per cent grade) for single lots of spot metal.

PALLADIUM — Per oz., $49@$52. Small lots bring up to $56. Absolutely no activity in market.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $80. Dealers and refiners quote the trade for refined metal, per oz., cash, $75@$79. Market very dull.

QUICKSILVER — Per 76-lb. flask, $119.50@$121.50, depending on quantity. San Francisco wires $121.33.

Prices of Cadmium, Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Tungsten, and Zirconium are unchanged from the issue of March 3.

Metallic Ores

MANGANESE ORE—Per long ton unit of Mn. c.i.f. North Atlantic ports, minimum 47 per cent Mn; 35@38c. Caucasian, washed, 53@55 per cent, 38.50@40c. Chemical grades unchanged from quotations in the March 3 issue.

TUNGSTEN ORE—Per unit of WO_3, N. Y.; Wolframite, $10.25@$10.50. Western scheelite, $10.50@$10.75. Market dead; prices nominal.

Chrome, Iron, Tantalum, and Titanium ores are unchanged from quotations in the March 3 issue.

Zinc Advances $2—Lead Unchanged

Joplin, Mo., March 10, 1928

Blende	Per Ton
High	$39.75
Premium blende, basis 60 per cent zinc	$38.00@ 39.00
Prime Western, basis 60 per cent zinc	37.00@ 38.00
Slimes and fines, 60 per cent zinc	33.00@ 36.00
Average settling price, all zinc	35.99
Galena	
High	$79.80
Basis 80 per cent lead	72.50
Average settling price, all lead	78.05

Shipments for the week: Blende, 9,216; lead, 1,407 tons.

It is currently reported that eight of the thirteen mills being operated night shifts will cease night work tonight; that two more will follow after this month, with a probability that the Anna Beaver Company and the Missouri-Kansas Zinc Corporation, two Eastern controlled properties, will join the restriction movement. Harry Payne Whitney, of the Anna Beaver, on a visit to the district during the winter, expressed himself in a local newspaper interview as favoring such a plan. It is also current talk that one after another of the larger producing mines will close down for a week at a time in an individual effort to restrict the output to the demand.

More than 1,200 tons of zinc concentrate per week was produced during February in excess of the estimated requirements of the retort smelters. Eliminating night work will, it is estimated, largely remedy this, and all other methods of restriction that may be adopted will tend to lower the reserve stock of zinc ore, now close to 60,000 tons. Buyers last week bought 9,150 tons, and this was balanced with this week's shipment. The purchase this week is 9,590 tons.

The price of zinc was advanced to $37 basis early in the week, and another advance to $38 basis was made today.

Platteville, Wis., March 10, 1928

Zinc Blende	Per Ton
Blende, basis 60 per cent	$38.75
Lead Ore	
Lead, basis 80 per cent lead	$72.50

Shipments for the week: Blende, 741 tons; lead, none. Shipments for the year: Blende, 7,198 tons; lead 560 tons. Shipments for the week to separating plants, 1,379 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, Tripoli, and Zircon are unchanged from prices in the March 3 issue.

Metallic Compounds

ARSENIOUS OXIDE (White Arsenic)—Per lb., 4c. A few good sales made.

Calcium Molybdate, Copper Sulphate, Sodium Sulphate (Salt Cake), Sodium Nitrate, and Zinc Oxide are unchanged from prices in the March 3 issue.

Ferro-Alloys

FERROMANGANESE—Per long ton, domestic and foreign, f.o.b. furnace or c.i.f. port of entry, $100 quoted for second quarter, 1928. Spiegeleisen, 19@21 per cent, $30@$32 f.o.b. furnace.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent, 90@93c. f.o.b. works.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium, and Ferrovanadium are unchanged from prices in the March 3 issue.

Metal Products

Rolled copper sheets, lead sheets, nickel silver, yellow metal are unchanged from issue of March 3.

ZINC SHEETS—Per lb., f.o.b. works, 9½c.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the issue of March 3.

Iron, Steel, and Coke

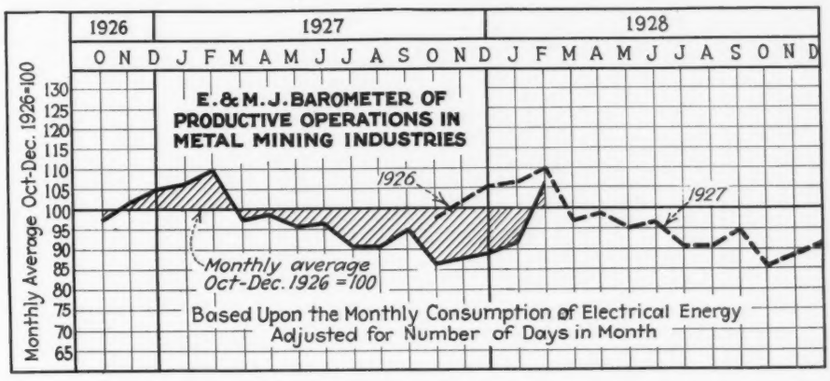
Iron—Per gross ton, Valley furnaces, Bessemer, $17.50; basic, $17; No. 2 foundry, $17.25@$17.50.

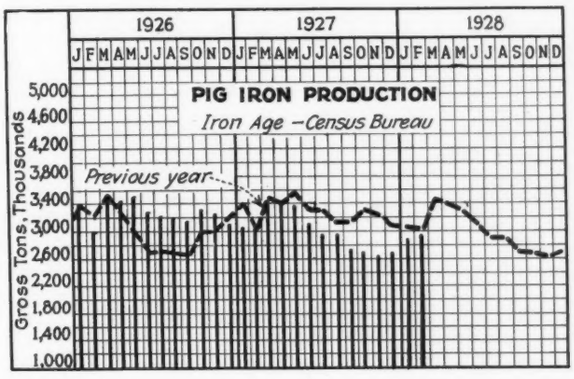
Steel—Base prices per gross ton, Pittsburgh, billets and slabs, $33; plates, structural shapes, and soft steel bars, per pound, 1.90c.

Coke—Per gross ton, Connellsville furnace, contract, $2.85@$3; spot, $2.65@$2.75. Connellsville foundry, contract, $3.75@$4.25; spot, $3.75@$4.25. By-product coke, Ohio and Kentucky, $7.50; Buffalo and Detroit, $9.

Indicators of Industrial Activity

of Significance to Mining


1926
1927
1928
O N D J F M A M J J A S O N D J F M A M J J A S O N D
E. & M. J. BAROMETER OF PRODUCTIVE OPERATIONS IN METAL MINING INDUSTRIES
Monthly Average Oct-Dec. 1926=100
130 125 120 115 110 105 100 95 90 85 80 75 70 65
1926
1927
Monthly average Oct-Dec. 1926 = 100
Based Upon the Monthly Consumption of Electrical Energy Adjusted for Number of Days in Month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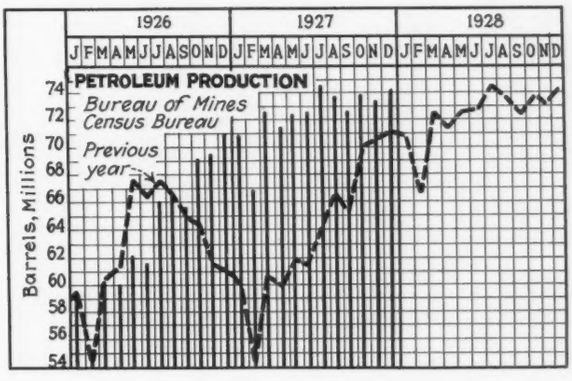
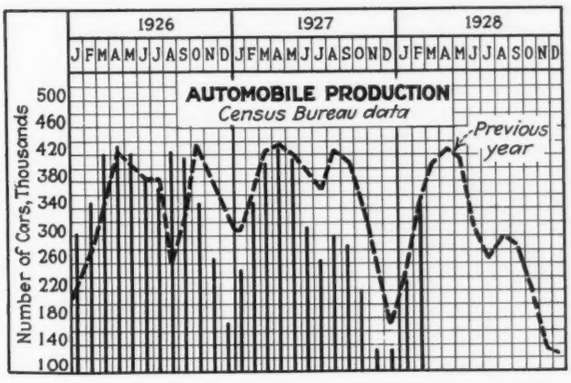
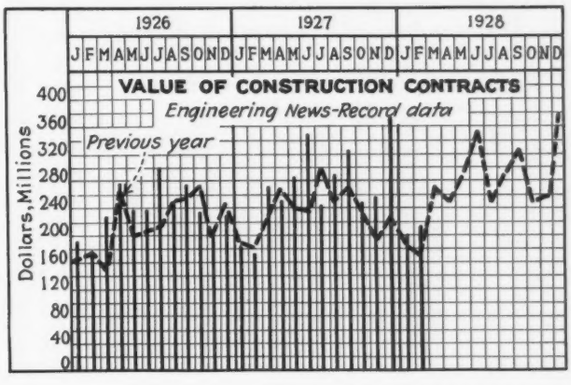
1927
1928
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
PIG IRON PRODUCTION
Iron Age — Census Bureau
Gross Tons, Thousands
5,000 4,600 4,200 3,800 3,400 3,000 2,600 2,200 1,800 1,400 1,000
Previous year


1926
1927
1928
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
PETROLEUM PRODUCTION
Bureau of Mines
Census Bureau
Barrels, Millions
74 72 70 68 66 64 62 60 58 56 54
Previous year


1926
1927
1928
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
AUTOMOBILE PRODUCTION
Census Bureau data
Number of Cars, Thousands
500 460 420 380 340 300 260 220 180 140 100
Previous year


1926
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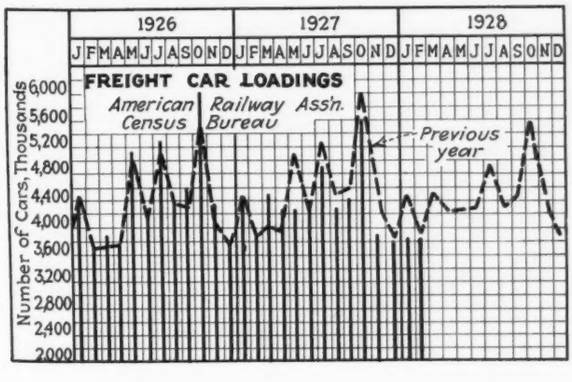
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
VALUE OF CONSTRUCTION CONTRACTS
Engineering News-Record data
Dollars, Millions
400 360 320 280 240 200 160 120 80 40 0
Previous year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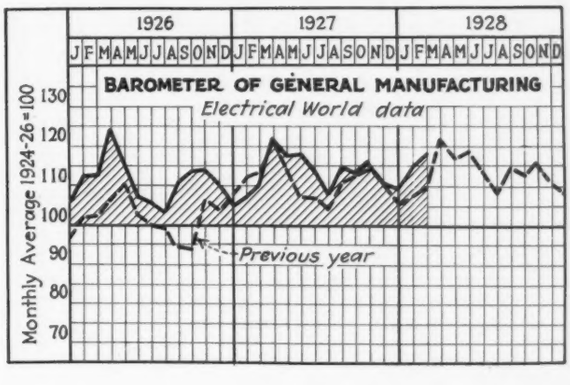
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
FREIGHT CAR LOADINGS
American Railway Ass'n. Census Bureau
Number of Cars, Thousands
6,000 5,600 5,200 4,800 4,400 4,000 3,600 3,200 2,800 2,400 2,000
Previous year


1926
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J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
BAROMETER OF GENERAL MANUFACTURING
Electrical World data
Monthly Average 1924-26=100
130 120 110 100 90 80 70
Previous year

Mining Stocks—Week Ended March 10, 1928

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	56	54	55⅛	Ja.14, Fe.20 Q	0.75
Arcadian Consol.	Boston	...	...	5½		
Aris. Com'l	Boston	5	4	4	Ja. 19, Ja. 31	0.25
Cal. & Ariz.	New York	98½	91½	94		
Calumet & Hecla	Boston	21⅝	20½	21½	No.30, De.15 Q	0.50
Cerro de Pasco	New York	63	61⅛	62⅛	Ja.12, Fe.8 Q	1.00
Chile Copper	New York	39	37⅛	37⅜	Ma. 2, Ma. 30Q	0.62
Con. Coppermines	N. Y. Curb	...	...	6		
Copper Range	Boston	16½	15⅛	15⅜	Ap.2, My.2, A	1.00
Crystal Copper	BostonCurb	*60	*48	*51		
East Butte	Boston	1⅛	1⅛	1⅛	Dec. 1919	0.50
Granby Consol.	New York	44	40	42½	Jn.15 Jy. 1 Q	1.00
Greene Cananea	New York	136	117½	132½	Nov., 1920	0.50
Howe Sound	New York	46½	44½	44⅛	De.31, Ja.16, Q	1.00
Inspiration Consol.	New York	18⅛	18	18⅛	Ma.17, Ap.4, Q	0.25
Iron Cap	Boston Curb	2½	2½	2½		
Isle Royale	Boston	12½	12¼	12⅜	Fe. 28, Ma. 15	0.50
Kennecott	New York	82⅛	81	81½	De. 2, Ja 3 Q	1.25
Magma Copper	New York	48½	45½	48½	Ma.2, Ap.2 Q	1.25
Mason Valley	N. Y. Curb	1⅛	1 1/16	1⅛		
Miami Copper	New York	18½	18	18⅛	Fe.1, Fe.15, Q	0.37½
Mohawk	Boston	49⅛	46½	49⅛	Ja. 28, Ma. 1 Q	1.00
Montana-Idaho	Spokane	*45	*42½	*43½		
Mother Lode Coal	New York	3⅜	3	3⅝	De.16, De.31	0.25
Nevada Consol.	New York	20⅛	19½	19¾	Ma.16, Ma.31 Q	0.37½
New Cornelia	Boston	26½	26	26⅛	Fe. 3, Fe. 20 Q	0.50
Noranda	N. Y. Curb	20	19⅜	19⅝		
North Butte	Boston	1⅛	1	1	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*90	*80	*86	Sept. 1926	0.03
Old Dominion	Boston	9⅛	9	9⅛	Dec., 1918	1.00
Phelps Dodge	N. Y. Curb	...	...	121½	De.17, Ja.3 Q	1.50
Quincy	Boston	14	12½	13	March, 1920	1.00
St. Mary's Min. Ld.	Boston	26	25½	26	Fe.10, Ma.10	2.00
Seneca Copper	New York	2½	2	2⅛		
Shattuck-Denn	N. Y. Curb	14⅛	13⅜	13⅜		
Tenn. C. & C.	New York	10⅛	10⅛	10⅛	Fe.29, Ma.15, Q	0.12½
United Verde Ex.	N. Y. Curb	20⅛	20⅛	20⅛	Ja.4, Fe 1 Q	0.50
Utah Copper	New York	145	143	143	Ma.16, Ma.31 Q	1.50
Utah Metal & T.	Boston	1⅛	1 1/16	1⅛	Dec., 1917	0.30
Walker Mining	Salt Lake	*84	*77	*78		
NICKEL-COPPER						
Internat. Nickel	New York	87⅛	80⅛	87⅛	Ma.15, Ma.31Q	0.50
Internat. Nickel pfd.	New York	112½	112½	112½	Fe. 17, Ma. 1 Q	0.62½
LEAD						
Gladstone Mtn.	Spokane	*9½	*8	*8½	June, 1927	0.005
National Lead	New York	129	124	129	Ma.16, Ma.31 Q	1.25
National Lead pfd.	New York	113⅛	113⅛	113⅛	Ap.23, My.1 Q	1.50
St. Joseph Lead	New York	40⅛	39¼	39½	Ma.9,Ma.20, QX	0.75
ZINC						
Am. Z. L. & S.	New York	17⅛	16	16	May, 1917	1.00
Am. Z. L. & S. pfd.	New York	76	69	72½	Nov., 1920	1.50
Butte C. & Z.	New York	6½	5⅛	6	De. 9, De. 24	0.50
Butte & Superior	New York	10⅛	10	10⅛	De.16, De.31 Q	0.50
Callahan Zn-Ld.	New York	2	1⅛	1⅜	Ma. 14, Ma. 31	0.50
Consol.Lead&Zinc'A'	St. Louis	11⅛	11⅛	11⅛	Ma.15, Ap.1 Q	0.25
Eagle-Picher	Cincinnati	17	15⅛	15⅛	No.15, De.1 Q	0.40
Eagle-Picher pfd.	Cincinnati	...	...	112	Jn.30, Oc.15 Q	1.50
New Jersey Zn.	N. Y. Curb	191	190	190½	Ja. 20, Fe. 10	2.00
Treadwell-Yukon	Toronto	26	26	26		
United Zinc	N. Y. Curb	....	....	25		
Yellow Pine	Los Angeles	....	....	*25	Dec. 1925 Q	0.04
GOLD						
Alaska Juneau	New York	4⅛	3⅛	4		
Argonaut	Toronto	*22½	*20	*21		
Barry-Hollinger	Toronto	1.15	*89	1.08		
Central Manitoba	Toronto	1.56	1.50	1.51		
Con.W.Dome L. new.	Toronto	*13½	*12	*13		
Cresson Consol. G.	N. Y. Curb	2 1/16	2⅛	2⅛	Ma.31, Ap.10 Q	0.10
Dome Mines	New York	11⅛	10½	11	Ma. 31, Ap. 20Q	0.25
Golden Cycle	Colo.Springs	†1.76	†1.74	....	Fe.29, Ma.10 Q	0.04
Gold Hill	Toronto	*30½	*25	*27		
Hollinger Consol.	Toronto	17.26	17.10	17.25	Ma. 7, Ma. 24	0.10
Homestake Mining	New York	71	71	71	Ma.20,Ma.26 Q	0.50
Kirkland Lake	Toronto	2.20	1.92	2.08		
Lake Shore	Toronto	24.25	23.85	24.00	Ma 1,Ma.15 QX	0.20
McIntyre-Porcupine	New York	....	....	27½	Fe. 1, Ma. 1 Q	0.25
Portland	Colo.Springs	†*29	†*24½	....	Ap.6, Ap.15, Q	0.02
Rand Mines	New York	....	....	40⅛	Au.22-29 Am.Sh.	1.52
Sylvanite	Toronto	3.70	3.45	3.45		
Teck-Hughes	Toronto	9.20	8.50	8.80	Fe.1, X	0.15
Tom Reed	Los Angeles	*32½	*30	*30	Dec., 1926	0.02
Tough-Oakes	Toronto	*63	*59	*62		
United Eastern	N. Y. Curb	*60	*55	*55	July, 1924	0.05
Vipond Cons.	Toronto	*56	*53	*56	Apr.1, Apr.15	0.03
Wright-Hargreaves	Toronto	5.75	5.00	5.25	Ja. 17, Fe. 1	0.05
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	27½	22⅜	25½		
Con. Cortez	N. Y. Curb	*23	*23	*23		
Dolores Esperanza	N. Y. Curb	*31	*30	*31	July, 1923	0.05
N.Y. Hond'o Rosario	N. Y. Curb	...	...	...		
Premier Gold	N. Y. Curb	2⅜	2⅛	2⅛	Ma.15, Ap. 4	0.08
Tonopah Belmont	N. Y. Curb	...	...	1⅜	Ma.15, Ap.4	0.08
Tonopah Extension	N. Y. Curb	*12	*10	*10	Apr. 1925	0.05
Tonopah Mining	N. Y. Curb	4	4	4	Se.20, Oc.21	0.07½
West End Consol.	N. Y. Curb	....	....	*5	Mar., 1923	0.05
Yukon Gold	Boston Curb	*60	*50	*50	June, 1918	0.02
SILVER						
Beaver Consol.	Toronto	1.70	1.57	1.62	May, 1920	0.03
Castle-Trethewey	Toronto	*63	*60	*62		
Coniagas	Toronto	4.75	4.70	4.75	May, 1924	0.12½
Keeley	Toronto	*62	*53	*62	Ma. 1, Ma. 15	0.04
Lorrain Trout Lake	Toronto	...	...	*60	July, 1925	0.05
Mining Corp. Can.	Toronto	3.75	3.60	3.70	Ja.10, Ja.25	0.15
Nipissing	N. Y. Curb.	5⅛	4⅞	5⅛	De. 31, Ja.20 Q	0.07½

Stock	Exch.	High	Low	Last		Last Div.
SILVER-LEAD						
Ahumada	New York	4½	2⅞	3⅜	Ma. 25,Ap.4,QX	0.12½
Bingham Mines	Boston	53⅛	52½	52⅝	Ja. 21, Fe. 1 Q	0.95
BunkerHill&Sullivan	N. Y. Curb	150½	150⅛	150½	Fe.29, Ma.5 QX	0.75
Cardiff M. & M.	Salt Lake	*64	*64	*64	Feb. 5, 1927	0.10
Chief Consol.	Salt Lake	3.75	3.35	3.65	Ja.10, Fe.1 Q	0.10
Consti'nMng.&Mill'g	Spokane	*18	*12	*12		
Erupcion	Boston Curb	*30	*22	*25	De.17, Ja.3 Q	0.07½
Eureka Lily	Salt Lake	1.77½	1.55	1.60		
Federal M. & S.	New York	...	...	140	Jn.25, Jn.29 Spec.	$10
Federal M. & S pfd.	New York	94⅛	94⅛	94⅛	Fe 24 Ma.15 Q	1.75
Hecla Mining	N. Y. Curb	17⅛	16⅛	16⅝	Fe.15, Ma.15 Q	0.25
Highland-Surprise	Spokane	*14½	*13	*14		
Iron King Mining	Salt Lake	*60	*58	*60		
Keystone Mining	Salt Lake	*35	*32	*32	Au. 12, Au. 26	0.07½
Lucky Jim	Spokane	*40½	*39	*40½		
Lucky Tiger-Com.	Kansas City	†8.10	†7.90	....	Ma.10, Ma. 20X	0.07
Mammoth Mining	Salt Lake	1.42½	1.37	1.37½	Jn.10, Jn.20 Q	0.05
North Lily	Salt Lake	5.65	4.65	5.65		
Park Utah	New York	11⅛	10⅜	10⅞	Ma. 15, Ap. 15 Q	0.20
Plutus Mining	Salt Lake	...	...	2.65	Oc. 25, No. 10 Q	0.10
Silver King Coal.	Salt Lake	11.00	10.37½	10.37½	Ma 20 Apr. 2,	0.25
Silversmith	Spokane	*20	*15	*19	Oct., 1926 Q	0.02
Strattons Mines	Spokane	*47	*44	*46		
Sunshine M. Co.	Spokane	1.30	1.00	1.30	Fe.10,Fe.20	0.02
Tamarack-Custer	Spokane	1.00	*90	*95	Sept., 1924	0.25
Tintic Standard	Salt Lake	13.87½	12.25	12.62½	De.20, Ja.3 QX	0.40
Utah-Apex	Boston	4⅛	4	4⅛	Oct., 1926	0.25
IRON						
Bethlehem Steel	New York	60⅛	57½	59⅛	Se. 2, Oc. 1	1.75
Cleveland-Cliffs Iron	Cleveland	134	110½	125	Ja.13, Ja.25 Q	1.00
Colorado Fuel & Iron	New York	74	69½	72⅛	May, 1921	0.75
Gt. North'n Iron Ore	New York	22⅜	21⅛	21⅛	Dec. 6, Dec. 28	0.75
Inland Steel	New York	51⅛	46	51	Fe.15 Ma.1 QX	0.66⅔
Replogle Steel	New York	...	...	12½		
Republic I. & S.	New York	63⅛	59½	61⅛	Fe. 15, Ma. 1 Q	1.00
Republic I. & S. pfd.	New York	108⅜	108⅜	108⅜	Ma. 15, Ap. 2 Q	1.75
Sloss-Sheffield S. & I.	New York	130	126	130	De. 10, De. 20 Q	1.50
Sloss-Shef. S.&I. pfd.	New York	...	...	119	De. 20, Ja.3 Q	1.75
U. S. Steel	New York	146⅛	140	144⅞	No. 30, De. 30 Q	1.75
U. S. Steel, pfd.	New York	140	139⅛	139⅛	Oc.30, No. 29 Q	1.75
Virginia I. C. & C.	New York	34	34	34	Jan., 1924	1.50
Virginia I.C.&C. pfd.	New York	62	62	62	De. 16, Ja. 3	2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM, TIN						
De Beers Consol.	New York	...	...	24	Jn. 26, Jn.30	1.45
So. Am. G. & P. New.	N. Y. Curb	3⅛	3⅛	3⅛		
Alum. Co. of Amer.	N. Y. Curb	126½	125	125½		
Alum. Co. of Amer. pf.	N. Y. Curb	107⅞	107⅛	107⅞	De. 15, Ja1 Q	1.50
Vanadium Corp.	New York	83⅜	77⅛	81⅛	Fe. 1, Fe. 15 Q	0.75
Patino M. & E.	New York	28	24⅛	27	De. 31, Ja. 14	4s.
ASBESTOS						
Asbestos Corp.	Montreal	33½	30	30⅛	Jan., 1926	1.50
Asbestos Corp. pfd.	Montreal	93	91	91	De.31, Ja.16 Q	1.75
SULPHUR						
Freeport Texas	New York	81	71	79½	Ja.14, Fe.1 QX	1.75
Texas Gulf	New York	74¼	70⅜	72⅞	Ma.1, Ma.15 Q	1.00
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	41⅜	40	40	Fe.18, Ma.1 Q	0.75
Amer. Metal, pfd.	New York	118	117½	117½	Fe.18, Ma.1 Q	1.75
Amer. Sm. & Ref.	New York	176	171½	173⅜	De.31, Fe. 1 Q	2.00
Amer. Sm. & Ref. pfd.	New York	132⅜	132⅜	132⅜	De.31, Ma.1 Q	1.75
Consol. M. & S.	Montreal	271	265	267	De. 31, Ja. 16 X	6.25
Newmont Mining	N. Y. Curb	163½	157	158⅜	Ja.3, Ja. 17	1.00
U. S. Sm. R. & M.	New York	41	39⅜	40	Ja. 6, Ja. 14 Q	0.87½
U.S. Sm. R.&M. pfd.	New York	53	52½	53	Ja. 6, .J3 14 Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. F, four weeks. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, J. A. Hogle & Co.; Colorado Springs, Colo., Henry Sachs.

LONDON QUOTATIONS—WEEK ENDED FEBRUARY 28, 1928

Name	High	Low	Last	Date	Amount	Last Div.
Aramayo Mines (25 frs.)	75/—	68/9	72/6	Feb., 1928	5	p.c. (†)
British Platinum (£1)	—/3	—/1⅛	—/3	Feb., 1925	2½	p.c.
Burma Corpn. (10 rupees)	13/4½	12/3	12/9	Jan., 1928	6	annas*
Bwana M'Kubwa (5s)	4/7½	3/10½	4/4½			
Camp Bird (2s)	3/10½	3/1½	3/7½			
El Oro (£1)	4/1½	3/4½	4/—	Nov., 1924	2½	p.c.*
Esperanza (10s)	—/1	—/1	—/1			
Frontino & Bolivia (£1)	13/9	13/6	13/9	Jan, 1928	5	p.c
Mexican Corpn. (£1)	9/6	6/—	9/6			
Mexico Mines of El Oro (£1)	32/—	22/6	31/3	Dec., 1926	3½	p.c.*
N'Changa Copper Mining	10/—	9/9	10/—			
Oroville Dredging (£1)	4/—	3/9	3/9	Dec., 1923	3⅜	p.c.
Ouro Preto (£1)	2/6	2/3	2/6	May, 1925	2½	p.c.
Rhodesian Congo Border (£1)	25/7½	22/6	23/9			
St. John del Rey (£1)	10/4½	10/—	10/3	May, 1927	3½	p.c.
San Francisco Mines (10s)	26/9	26/—	26/3	Jan, 1928	25s.	*
Santa Gertrudis (£1)	16/—	14/9	15/9	Jan., 1928	7½	p.c
Selukwe (2s. 6d.)	7/9	6/3	7/6	April, 1917	6¼	p.c
S. Amer. Copper (2s.)	1/6	—/10½	1/4½	Nov., 1917	75	p.c
Tanganyika (£1)	71/9	57/6	60 7½	Aug., 1927	7½	p.c.
Union Miniere du Haut-Katanga (Brussels)	11.200	11.135	11.135	July, 1927	182.60	(‡)

* Free of British income tax. † Swiss francs and plus 15 p. c. bonus. ‡ Belgian frs. and free of taxation.